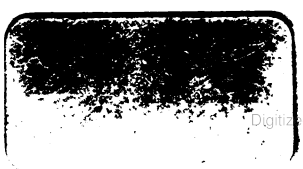

STATE OF VERMONT.

FIRST ANNUAL REPORT

— OF THE —

State Agricultural Experiment Station.

1887.

RUTLAND:
THE TUTTLE COMPANY, OFFICIAL PRINTERS.
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THE
Vermont State Agricultural Experiment Station.

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ANNOUNCEMENT.

—:o:—

The Vermont State Agricultural Experiment Station was established in accordance with an Act of the General Assembly approved Nov. 24th, 1886, for the purpose of promoting agriculture by scientific investigation and experiment.

The Station is prepared to analyze and test fertilizers, cattle foods, seeds, soils, milk and other agricultural materials and products, to identify grasses, weeds and useful or injurious insects, and to give information on various subjects of agricultural science for the use and advantage of the citizens of Vermont.

All chemical analyses, seed investigations, etc., proper to an experiment station, that can be used for the public benefit, will be made without charge. The Station will undertake no work the results of which are not at its disposal to use or publish if deemed advisable for the public good. The results of each analysis or examination will be promptly communicated to the party sending the sample. Those that are of general interest will be published in bulletins, copies of which will sent to each post-office in the State. The work of the year will be summed up in the annual report of the Station.

It is the wish of the Board of Control to make the Station as widely useful as its resources will admit. Every Vermont citizen who is concerned in agriculture, whether farmer, manufacturer or dealer, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond to all applications as far as lies in its power. All communications on agricultural and horticultural topics will be fairly considered and as far as possible promptly answered. Any one desising to send samples or specimens for examination

should first write to the Experiment Station and get blanks and directions for taking samples.

Parcels by express, to receive attention, should be prepaid.

The Station offices and laboratory are in the Station Building, corner of Main St. and University Place. The Station farm is in South Burlington. The Station has telephone connection and may be spoken from the Central Telephone Office and any Hotel in Burlington, and from the Telephone Stations at Essex Junction, Georgia, Milton, St. Albans, Williston, Winooski and Montpelier.

W. W. COOKE, Director,
Burlington, Vt.

☞Address all communications, not to any individual officer, but to the Agricultural Experiment Station, Burlington, Vt.

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REPORT OF THE DIRECTOR.

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The law creating the Vermont State Agricultural Experiment Station placed it under the charge of the University of Vermont and State Agricultural College. The University at once turned over to the uses of the Station the large brick building formerly occupied by the Medical Department, thus furnishing ample room for the offices and laboratories of the Station, but owing to the limited appropriation, two rooms only were fitted up at first for its use. The first appropriation dated from Dec. 1st, 1886. By March 1st, 1887, a chemical laboratory had been furnished, well equipped throughout for agricultural investigation, and active work was commenced.

This report covers the first twelve months of the actua work of the Station, ending March 1st, 1888.

The sampling and analysis of commercial fertilizers licensed for sale in the State has necessarily occupied a large part of the attention of the Station during the past year. As required by law, at least three samples have been drawn of each brand, from places widely separated in the State, so that the average of these shall represent as fairly as possible the average quality of the goods. In all, about 125 different samples of licensed fertilizers have been drawn and analyzed. In addition to this, the Station has analyzed various fertilizing materials, as follows :

Mixed fertilizers, 9 samples,
Bone Meal, 9 samples,
Agricultural chemicals, 8 samples,
Minerals, 5, Ashes, 3, samples,
Muck, 2 samples,
Farm-yard manure, 3, samples,
Miscellaneous, 4,

As the Station had no farm of its own, it was necessary that any field or feeding experiments undertaken should be conducted on the farms of others. In answer to a request

published in the newspapers of the State, many farmers gave us the use of their land and equipments, and the Station desires to express here its thanks to the farmers who have so generously aided it in its investigations. Three general lines of work were laid out for these experiments on the various farms throughout the State:

1. An experiment with fertilizers, to answer the question whether South Carolina rock and bone-black in their undissolved form could be profitably used by farmers as a fertilizer for the hay crop.

2. Tests of new fodder plants, the following varieties being tried: Alfalfa, Cowpea, Seradella, Winter Vetch, Spring Vetch and Yellow Lupine.

3. Feeding experiments with milch cows, to determine the effect of various rations on the quantity and quality of the milk.

4. Besides these, the Station has made numerous analyses of various feeding materials, some at the request of farmers in the State, and others in connection with the feeding and field experiments above mentioned. In the following pages will be found a more detailed account of the work.

The Station has issued seven bulletins during the year, as follows:

No. 1. Analyses of Licensed Fertilizers. Issued March 31 1887.

No. 2. Analyses of Licensed Fertilizers. Issued June 30, 1887.

No. 3. Analyses of Bone Meal. Issued August 11, 1887.

No. 4. Field and Feeding Experiments with Cowpea and Seradella. Issued November 22, 1887.

No. 5. The Availability of the Nitrogen in Fertilizers. Issued January 23, 1888.

No. 6. Analyses of Ashes, Bone Meal and Licensed Fertilizers. Issued February 27, 1888.

No. 7. Report of the Meeting of Agriculturists to consider the work of the Station under the provisions of the Hatch Bill. Issued March 1, 1888.

Under the Hatch Bill the Station will hereafter receive $15,000 a year. This will enable it to increase the scope and

variety of its work. A farm has been purchased and suitable buildings have been erected and well stocked to make a fully equipped experimental farm, so that hereafter the Station will be enabled to carry on its work in the following definite lines of research:

1. Field experiments with the principal farm crops of the State.
2. The feeding of farm stock.
3. The study of various fruits and vegetables adapted to the soil and climate of the State.
4. The study of milk and all of its products.
5. The diseases of plants.
6. The study of insects injurious to vegetation.
7. Fertilizers, both in the field and the laboratory.
8. Miscellaneous chemical work which may be sent in by the farmers of the State.

VERMONT FERTILIZER LAW.

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It is hereby enacted by the General Assembly of the State of Vermont:

SECTION 1. Manufacturers and importers of commercial fertilizers, sold or offered for sale in this State, shall, before such fertilizer is sold or offered for sale, obtain a license from the State treasurer, countersigned and recorded by the secretary of the board of agriculture, for each brand of fertilizer so sold or offered for sale, authorizing the sale of the same in the State, and shall securely affix to each barrel, bag, or other package of such fertilizer the word "licensed," with the number and date of the license. The person obtaining such license for a brand of fertilizer shall pay to the State fifty dollars for each brand licensed, and the license shall be valid for one year.

SEC. 2. Manufacturers and importers of commercial fertilizers sold or offered for sale in this State, shall, before such fertilizer is so sold or offered for sale, file with the State treasurer a bond, with sureties residing in the State satisfactory to said treasurer, in the sum of five thousand dollars, payable to the State, conditioned for the payment of forfeitures and costs imposed on such manufacturers or importers for violating the provisions of this act, and such bond shall be renewed from time to time, as the State treasurer may require.

SEC. 3. Manufacturers and importers of commercial fertilizers sold or offered for sale in this State, shall, before such fertilizer is sold or offered for sale, securely affix to each barrel, bag or package of such fertilizers, a label wherein they shall state in legible print, the name and place of business of such manufacturer or importer, the year of the manufacture of such fertilizer, or, if the fertilizer is imported, the year of its importation, and net weight of the same, also the constituent parts of

such fertilizer, and the percentage of nitrogen, of potash, of soluble, reverted and insoluble phosphoric acid.

SEC. 4. A manufacturer or importer of commercial fertilizers, sold or offered for sale in this State, who violates any of the provisions of this act, shall forfeit to the State one thousand dollars, to be recovered in an action on the bond required to be filed by such manufacturer or importer, under the provision of section two of this act.

And it shall be the duty of the secretary of the board of agriculture to notify the State treasurer of all violations of the provisions of this act, and the State treasurer shall immediately commence suit on the bond in the name of the State, and prosecute the same to final judgment.

SEC. 5. The word "importers" in this act shall be construed to mean persons importing fertilizers directly from countries without the United States.

SEC. 6. The term "commercial fertilizers," as used in this act, shall be taken to mean compounded and manufactured substances containing or represented to contain two or more ingredients mentioned in section three of this act, but shall not apply to the separate ingredients used to manufacture the same when sold in their pure condition, or to bone meal, land plaster, lime or any substance the product of nature which has not been compounded.

SEC. 7. A person who sells or keeps for sale a commercial fertilizer, the manufacturers or importers whereof have not complied with the provisions of sections one and two of this act, and the barrels, bags or packages whereof are not marked with legibly printed labels purporting to specify the particulars required to be specified in such labels by section three of this act, shall be fined two hundred dollars.

SEC. 8. The agents in this State of the manufacturers or importers of a commercial fertilizer may sell any commercial fertilizers in their possession in this State at the time of the passage of this act, although the same is not labeled in conformity with the provisions of section two of this act.

SEC. 9. The chemist of the University of Vermont and State Agricultural College shall be ex-officio State chemist for the purposes named in this act.

SEC. 10. It shall be the duty of the secretary of the State board of agriculture by himself, or by some suitable person, to be appointed for that purpose, to draw at least three samples in each year of each brand of fertilizers kept for sale in the State, from stock in the hands of the agents or dealers in the same, which drawings shall be made in the presence of at least two witnesses, and without any previous notice or information of such drawing to the manufacturer, or agent, or dealer in such fertilizer.

Each sample so drawn shall be divided into three parts, and placed in tin or glass vessels and carefully sealed, which shall each have a label placed thereon, stating the name of the manufacturer of said sample and the brand or trade mark under which it is sold, from what agent or dealer, and when and where the same was drawn, which label shall be signed by the secretary or other persons drawing the same, and by the witnesses present at said drawing and sealing up of said samples.

One of said vessels containing said samples shall be kept by the agent or dealer, one shall be kept by the secretary of the board of agriculture, and one shall be sent to the State chemist, who shall properly analyze the same, and duly report to the secretary of the board of agriculture the result of said analysis, stating the methods used by him to determine the amounts of potash, nitrogen, soluble, reverted and insoluble phosphoric acid, and such amounts; and said secretary of the board of agriculture shall cause such reports to be published, giving the name of the chemist making the same.

SEC. 11. If the secretary of the State board of agriculture, or the State chemist making the analysis, shall violate, or knowingly fail to perform his duty, as prescribed in said section, or shall collude with any manufacturer of, or agent or dealer in, any fertilizer, to evade the provisions of said section, so as to injure any manufacturer of, agent or dealer in any fertilizer, such secretary or chemist shall, upon conviction thereof, be sentenced to pay a fine of one thousand dollars.

SEC. 12. The University of Vermont and State Agricultural College shall receive five dollars for each analysis made under the provisions of section nine of this act. The secretary of the board of agriculture shall receive fifty cents for recording

each license, and two dollars a day for time necessarily spent in drawing samples, and his traveling expenses incurred in the discharge of such duty. Such fees and compensation shall be paid from the State treasury, but the fees and compensation incident to the drawing of samples and analyzing any one brand of fertilizer and recording the license for such brand, shall not exceed the amount paid for such license.

SEC. 13. This act shall take effect from its passage.

Approved November 29, 1882.

No. 89.—AN ACT TO AMEND NUMBER ONE HUNDRED AND NINETEEN OF THE ACTS OF 1882, RELATING TO COMMERCIAL FERTILIZERS.

It is hereby enacted by the General Assembly of the State of Vermont:

SECTION. 1. Section one of number 119 of the acts of 1882 is hereby amended so as to read as follows: Manufacturers and importers of commercial fertilizers sold or offered for sale in this State, shall, before such fertilizer is sold or offered for sale, obtain a license from the State treasurer, countersigned and recorded by the secretary of the board of agriculture, for each brand of fertilizer so sold or offered for sale, authorizing the sale of the same in the State, and shall securely affix to each barrel, bag or other package of such fertilizer the word "licensed," with the number and date of the license. The person obtaining such license for a brand of fertilizer shall pay to the State fifty dollars for each brand licensed, and the licenses shall expire on the thirty-first day of December of the year for which they are issued.

SEC. 2. This act shall take effect from its passage.

Approved November 25, 1884.

VERMONT EXPERIMENT STATION LAW.

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NO. 73.—AN ACT TO ESTABLISH A STATE AGRICULTURAL EXPERIMENT STATION.

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It is hereby enacted by the General Assembly of the State of Vermont:

SECTION 1. For the promotion of scientific and practical agriculture, and for preventing frauds and adulterations in commercial fertilizers, foods, feeding stuffs, seeds, and commercial products, there is hereby established a State agricultural experiment station, in connection with, and under the control of the University of Vermont and State Agricultural College.

SEC. 2. The trustees of the University of Vermont and State Agricultural College shall appoint annually two of their number, who, with the president of said institution as their chairman, shall act as a board of control for said State agricultural experiment station. It shall be the duty of the board of control to appoint a director and such other officers and employes as they may deem proper for the State agricultural experiment station, and to audit all bills for its expenses, and to have general oversight and direction of its affairs.

SEC. 3. The director and other officers of the State agricultural experiment station shall investigate such subjects as the board of control may from time to time direct, but they are especially charged:

1. With investigations relating to the ravages of insects and the dissemination of such information as may be deemed advisable for their abatement.

2. With investigations and experiments directed to the introduction and fostering of new agricultural industries adapted to the various climates and soils of the State, and especially of new fodder plants and feeding stuffs.

3. With conducting experiments on the nutrition and growth of plants, with a view to ascertain what fertilizers are best suited to the various crops of this State.

SEC. 4. Any farmer or other resident of this State, purchasing for his own use a commercial fertilizer that has been duly licensed for sale in the State, may require the dealer to draw in his presence a sufficient quantity of said commercial fertilizer to serve as a sample for chemical analysis, and said dealer shall certify that the sample drawn fairly and correctly represents the average composition of the fertilizer sold. The above mentioned sample shall be sent by the buyer in a sealed vessel, charges prepaid, to the State agricultural experiment station, accompanied by a certified statement from the buyer, giving the name and address of the manufacturer, the name and address of the agent or person from whom it was purchased, the date of its manufacture, the date and place of drawing the sample, and its guaranteed composition and selling price. The director of the State agricultural experiment station shall cause to be analyzed, free of charge, all such samples, and shall send copies of the analysis, as soon as made, to the person sending the sample and to the dealer from whom it was purchased; provided, that there shall not be required in any one year more than two such analyses of the same brand of fertilizer.

SEC. 5. The officers and employes of the State agricultural experiment station shall, so far as time and means permit, make analyses of all samples received of unlicensed commercial fertilizers, home made fertilizers, and the material for composting the same. They shall also analyze soils, feeding stuffs, milk, butter, oleomargarine and other substitutes for butter, drinking water, and other substances or products, provided that in their judgment such analyses would be for the advancement of the public good. All such analyses shall be free of charge to residents of this State.

SEC. 6. The director of the State agricultural experiment station shall from time to time publish bulletins of its work for general distribution. Copies of these bulletins shall be furnished free of charge to any one sending his address, and at least two copies of each bulletin shall be sent to each post-office in the State. The director shall publish an annual report for free distribution.

SEC. 7. The sum of three thousand five hundred dollars, annually, is hereby appropriated to the University of Vermont and State Agricultural College for the support and maintenance of the above mentioned State agricultural experiment station, to be paid on the warrant of the governor, semi-annually, on the first day of December and June, the first payment to be on the first day of December, 1886.

SEC. 8. All duties prescribed by act one hundred and nineteen of the laws of 1882, relating to commercial fertilizers, to be performed by the secretary of the board of agriculture, shall hereafter be performed by the director of the State agricultural experiment station.

SEC. 9. This act shall take effect from its passage.

Approved November 24, 1886.

THE UNITED STATES EXPERIMENT STATION LAW.

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An act to establish agricultural experiment stations in connection with the colleges established in the several States under the provisions of an act approved July 2, 1862, and of the acts supplementary thereto.

SECTION 1. Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science, there shall be established, under the direction of the college, or colleges, or agricultural department of colleges, in each State or Territory established, or which may hereafter be established, in accordance with the provisions of an act approved July 2, 1862, entitled "An act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts," or any of the supplements to said act, a department to be known and designated as an "agricultural experiment station:" Provided, that in any State or Territory in which two such colleges have been or may be so established, the appropriation hereinafter made to such State or Territory shall be equally divided between such colleges, unless the Legislature of such State or Territory shall otherwise direct.

SEC. 2. That it shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative

cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories.

SEC. 3. That in order to secure, as far as practicable, uniformity of methods and results in the work of said stations, it shall be the duty of the United States commissioner of agriculture to furnish forms, as far as practicable, for the tabulation of results of investigation or experiments; to indicate, from time to time, such lines of inquiry as to him shall seem most important; and, in general, to furnish such advice and assistance as will best promote the purposes of this act. It shall be the duty of each of said stations, annually, on or before the first day of February, to make to the governor of the State or Territory in which it is located, a full and detailed report of its operations, including a statement of receipts and expenditures, a copy of which report shall be sent to each of said stations, to the said commissioner of agriculture, and to the secretary of the treasury of the United States.

SEC. 4. That bulletins or reports of progress shall be published at said stations at least once in three months, one copy of which shall be sent to each newspaper in the States or Territories in which they are respectively located, and to such individuals actually engaged in farming as may request the same, and as far as the means of the station will permit. Such bulletins or reports, and the annual reports of said stations, shall be transmitted in the mails of the United States free of charge for postage, under such regulations as the postmaster-general may from time to time prescribe.

SEC. 5. That for the purpose of paying the necessary expenses of conducting investigations and experiments and print-

ing and distributing the results as hereinbefore prescribed, the sum of $15,000 is hereby appropriated to each State, to be specially provided for by Congress in the appropriations from year to year, and to each Territory entitled under the provisions of section eight of this act, out of any money in the treasury proceeding from the sales of public lands, to be paid in equal quarterly payments on the first day of January, April, July and October in each year, to the treasurer or other officer duly appointed by the governing boards of said colleges to receive the same, the first payment to be made on the first day of October, 1887: Provided, however, that out of the first annual appropriation so received by any station an amount not exceeding one-fifth may be expended in the erection, enlargement, or repair of a building or buildings necessary for carrying on the work of such station; and thereafter an amount not exceeding 5 per centum of such annual appropriation may be so expended.

SEC. 6. That whenever it shall appear to the secretary of the treasury, from the annual statement of receipts and expenditures of any of said stations that a portion of the preceding annual appropriation remains unexpended, such amount shall be deducted from the next succeeding annual appropriation to such station, in order that the amount of money appropriated to any station shall not exceed the amount actually and necessarily required for its maintenance and support.

SEC. 7. That nothing in this act shall be construed to impair or modify the legal relation existing between any of the said colleges and the government of the States or Territories in which they are respectively located.

SEC. 8. That in States having colleges entitled under this section to the benefits of this act, and having also agricultural experiment stations established by law separate from said colleges, such States shall be authorized to apply such benefits to experiments at stations so established, by such States; and in case any State shall have established, under the provisions of said act of July 2 aforesaid, an agricultural department or experimental station in connection with any university, college, or any institution not distinctively an agricultural college or school, and such State shall have established, or shall hereafter establish a separate agricultural college or school, which

shall have connected therewith an experimental farm or station, the legislature of such state may apply in whole or in part the appropriation by this act made, to such separate agricultural college or school; and no legislature shall, by contract, express or implied, disable itself from so doing.

SEC. 9. That the grants of moneys authorized by this act are made subject to the legislative assent of the several States and Territories to the purpose of said grants: Provided, That payments of such installments of the appropriation herein made as shall become due to any State before the adjournment of the regular session of its legislature meeting next after the passage of this act shall be made upon the assent of the governor thereof duly certified to the secretary of the treasury.

SEC. 10. Nothing in this act shall be held or construed as binding the United States to continue any payments from the treasury to any or all the States or institutions mentioned in this act, but Congress may at any time amend, suspend or repeal any or all of the provisions of this act.

OBSERVANCE OF THE FERTILIZER LAW.

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List of manufacturers who have paid licenses as required by the fertilizer law and of the fertilizers which have been thus licensed for sale in the State during the year ending December 31, 1887:

FIRM.	BRAND OF FERTILIZER.
Bowker Fertilizer Co., Boston, Mass.	Bowker's Hill and Drill Phosphate. Stockbridge Manure. Potato Phosphate. Ammoniated Dissolved Bone.
Bradley Fertilizer Co., Boston, Mass.	Bradley's X L Superphosphate. B. D. Sea Fowl Guano. Potato Manure. Original Coe's Superphosphate
Buffalo Fertilizer Co., Buffalo, N. Y.	Buffalo Ammoniated Bone Superphosphate. Buffalo Superphosphate for Potatoes, Hops and Tobacco. Buffalo Spec'l Superphosphate.
Clark's Cove Guano Co., New Bedford, Mass.	Bay State Fertilizer.
Cleveland Dryer Co., Cleveland, O.	Cleveland Superphosphate.
Coe, E. Frank, New York, N. Y.	High Grade Superphosphate.

FIRM.	BRAND OF FERTILIZER.
Common Sense Fertilizer Co., Boston, Mass.	Common Sense Fertilizer, No. 1. " " " " 2. Special Soluble Fertilizer, No. 22.
Cumberland Bone Co., Portland, Me.	Cumberland Superphosphate. Cumberland Seeding Down Fertilizer.
Flamingo Guano Co., Baltimore, Md.	Liebig's Ammoniated Superphosphate.
Glidden & Curtis, Boston, Mass.	Soluble Pacific Guano.
Michigan Carbon Works, Detroit, Mich.	Homestead Fertilizer.
Orient Guano M'f'g Co., Orient, L. I.	Orient Complete Manure.
Quinnipiac Co., New London, Conn.	Quinnipiac Phosphate. Quinnipiac Potato Manure. Pine Island Phosphate.
Standard Fertilizer Co., Boston, Mass.	Standard Fertilizer. Standard Guano.
Tucker, J. A., Boston, Mass.	Bay State Bone Superphosphate of Lime.
Williams & Clark Co., New York, N. Y.	Americus Ammoniated Superphosphate. Special Potato Fertilizer.

NOTE.—No samples of Original Coe's Superphosphate could be found in the State, and hence no analyses have been made of this brand.

INSPECTION OF FERTILIZERS.

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During the past year the Station has drawn and analyzed about one hundred and twenty-five samples of licensed fertilizers.

In order that the analysis of a fertilizer may be of value, it must fairly represent the average composition of that fertilizer. Great care is necessary in drawing a sample for analysis, to get one that is a fair sample. In this State a sampling tube is used that takes a section or core out of the entire length of the package, and thus insures fair sampling. In addition to this precaution, the State law requires the analysis of at least three different samples of each brand, so that the average of these may be taken to fairly represent the general character of the fertilizer. All the samples analyzed in 1887 were drawn by the Director of the Experiment Station, either in person or by deputy.

EXPLANATION OF TERMS.

The following explanations of the meaning of the terms used to designate the valuable ingredients of fertilizers, is taken largely from the last Vermont report of fertilizer analyses for 1886.

The ingredients of commercial fertilizers upon which both their agricultural and commercial values chiefly depend are nitrogen, phosphoric acid, and potash. Besides these more valuable ingredients, sulphuric acid and lime are always present in superphosphates in considerable quantities, being a necessary accompaniment of phosphoric acid as it exists in all fertilizers.

Nitrogen is the most costly of the three important ingredients mentioned, and adds largely to the commercial value of all the fertilizers sold in Vermont. It is found in the wholesale markets in quite a variety of substances which are used to supply this ingredient to mixed fertilizers, but which are available

for fertilizing purposes when purchased unmixed with anything else. *Organic Nitrogen* is the nitrogen of animal and vegetable tissues. The following materials furnish organic nitrogen to fertilizers: Dried blood, dried and ground fish, azotin and ammonite (prepared animal matter), fish scrap, meat scrap, cotton seed meal, castor pomace, horn, hair, wool, leather-waste, etc. These substances must decompose and the nitrogen become changed into compounds of *nitric acid and ammonia* before it is available to plants. There is, therefore, a great difference in the value of organic nitrogen as found in the above-named materials. Dried blood, for instance, decomposes in the soil rapidly, while horn, hair, wool and leather scrap, decay very slowly, and the nitrogen which they contain becomes useful only after a long period of time. These latter substances are not only less useful to the farmer than blood, fish and meats, but they are also much less costly, and their presence in a fertilizer supposed to be manufactured of the best materials is good evidence of fraud. Compounds of ammonia and nitric acid also occur in commerce, the former in sulphate of ammonia, the latter in nitrate of soda. Seventeen parts of ammonia, or sixty-six parts of pure sulphate of ammonia, or eighty-five parts of pure nitrate of soda, each contain fourteen parts of nitrogen.

The *phosphoric acid* of superphosphates is determined in three forms according to its solubility in various liquids, viz: *soluble*, *reverted*, and *insoluble*.

Soluble phosphoric acid is that which exists in fertilizers in a form freely soluble in water. It is obtained by treating certain phosphatic materials, such as bone and South Carolina rock, with sulphuric acid (oil of vitriol). The advantage of having the phosphoric acid of fertilizers rendered soluble, is not that it remains so in the soil, for it becomes insoluble in water very shortly after application, but in the fact that when the compounds of the soil change it back to insoluble forms it becomes deposited in particles so minute that they are easily appropriated by the roots of plants.

Reverted phosphoric acid is a term that originally signified phosphoric acid that had once been "soluble," but which from some cause had "reverted," or "gone back" to forms insoluble in water. Now it is used to designate that which is dissolved

by a solution of ammonium citrate, and includes not only the truly reverted, but also more or less of phosphoric acid as combined in the original, undissolved phosphatic material. Reverted phosphoric acid, in so far as it comes within the strict meaning of the term, most probably has a value for crop production, equal to that of the soluble form, but it is not clear that this holds true of that which would be dissolved by ammonium citrate, from finely ground South Carolina rock, for instance.

Insoluble phosphoric acid is that which is readily soluble neither in water nor in a solution of ammonium citrate, but which can be dissolved in strong acids. In some cases the phosphoric acid is too insoluble to be readily available as plant food. This is especially true of Canada apatite. Bone black, bone ash, South Carolina rock and Navassa phosphate, when in coarse powder are commonly of little repute as fertilizers, though good results are occasionally reported from their use. When finely pulverized ("floats") they more often act well, especially in connection with abundance of decaying vegetable matters. The phosphate of raw bones is nearly insoluble, because of the animal matter of the bones which envelopes it; but when the latter decays in the soil, the phosphate remains in essentially the "reverted" form.

It should be remembered that the terms "soluble," "reverted," and "insoluble," are merely relative in their significance. There is no compound of phosphoric acid that is not dissolved to a slight extent, at least, in pure water, and to a still greater degree by ammonium citrate, and the extent of the solubility of raw phosphates in these liquids, and in weak acids such as are found in the roots of plants, depends very largely upon their mechanical condition, or the degree of fineness to which they are ground.

The *potash* used in this country for agricultural purposes, comes mostly from Germany in the so-called "German potash salts," which include sulphate of potash, muriate of potash (potassium chloride) and kainite. Except for a few special purposes, potash is equally valuble in all these forms, but costs least in the muriate and in kainite.

In their raw or unmixed state, little use is made in Vermont of the various materials of which complete commercial

fertilizers are compounded. These materials, such as dried blood, fish scrap, ground bone, bone black, South Carolina rock, muriate of potash and kainite are not required by the fertilizer law to be licensed or analyzed. A discussion of their analyses and valuations is given in another part of this volume.

THE VALUATION OF FERTILIZERS.

In common with all American experiment stations that stand in an official relation to the fertilizer trade, a schedule of trade values is given to the fertilizers analyzed. By means of these trade values there is calculated for each brand what has been designated as the "estimated value" or the "station valuation." As these estimated values are not intended to represent the proper selling price of mixed goods at the point of consumption, and in order to prevent any possible misapprehension as to their real meaning, the following explanations are offered:

1. These trade values represent very closely the prices at which a pound of nitrogen, phosphoric acid and potash, in their various forms, can now be purchased at retail in our large markets. They are based mostly upon the ton prices at which certain classes of goods are offered to actual consumers, and correspond also to "the average wholesale prices for the six months ending March 1st, plus about twenty per cent in the case of these goods for which we have wholesale quotations."

2. These trade values do not include the charges for transportation from the market to the consumer, for storage, mixing, commissions to agents and dealers, selling on long credit, bad debts, etc., etc.

3. They are the prices of nitrogen, phosphoric acid and potash, *ready for use by the farmer*, when these ingredients are purchased under the above named conditions, singly and not mixed. In ordinary superphosphates we find these three ingredients mixed, but this not a necessary condition of their use.

An illustration may serve to make clear the above statements. A farmer wishes a ton of fertilizer similar to the well-known brands sold in this State. If he purchases for cash in New York or Boston sixteen hundred (1600) pounds of dissolved bone black, three hundred (300) pounds of sulphate of ammonia, and one hundred (100) pounds of muriate of potash, and mixes

these ingredients together, he will have a complete fertilizer not essentially different from many standard brands of ammoniated superphosphates. The cost of the ton after mixing (if the farmer prefers to mix the ingredients) will be made up as follows:

(*a*). Cost of the materials in the markets.

(*b*). Cost of transportation.

(*c*). Cost of mixing.

The first element entering into the total cost is the only one included in the "estimated value." If there is added to this one element, not only the charges for transportation and mixing, but also the expenses of selling through agents and dealers, long credits, bad debts, etc., we have the factors involved in the cost of our ordinary superphosphates, when delivered at or near the place of consumption. As is to be expected, the station valuations of superphosphates fall below their selling prices. In 1885, the average difference in Vermont was $9.92 per ton; this year it is $10.01. This slight increase of difference is not due to an inferiority in the fertilizers, but to a lowering of the scale of valuation.

4. The station valuations stand in no direct or necessary relation to the comparative profits which may be derived from the use of the various fertilizers by individual farmers. These values have an almost purely commercial significance, and are not designed to point out to the farmer whether he shall use potash, which is a comparatively cheap ingredient, or nitrogen, which is comparatively costly. If ordinary superphosphates are compared, however, on the basis of commercial valuations, it will be found to be true in general that their fertilizing power is in proportion to their money value.

The following schedule of trade values used in this State, in 1887, is the one agreed upon by the experiment stations of Massachusetts, Connecticut, and New Jersey, after a careful study of prices ruling in the large markets of New England and the Middle States.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals for 1887.

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	1886. cts. per lb.	1887. cts. per lb.
Nitrogen in ammonia salts,	18½	17½
" in nitrates,	18½	16
Organic nitrogen in dried and fine ground fish,	17	17½
" " in dried and fine ground blood,	17	16½
Organic nitrogen in cotton seed, linseed meal and castor pomace,	17	17½
Organic nitrogen in fine ground bone,	17	16
" " in fine medium bone,	15	14
" " in medium bone,	13	12
" " in coarse medium bone,	11	10
" " in coarse bone, horn shavings, hair and fish scrap,	9	8
Phosphoric acid soluble in water,	8	8
" " " in ammonium citrate,*	7½	7½
" " " in dry fine ground fish and in fine bone,	7	7
Phosphoric acid in fine medium bone,	6	6
" " in medium bone,	5	5
" " in coarse medium bone,	4	4
" " in coarse bone,	3	3
" " in fine ground rock phosphate,	2	2
Potash as high grade sulphate,	5½	5½
" " kainite,	4¼	4¼
" " muriate,	4¼	4¼

* Dissolved from 2 grams of the unground phosphate previously extracted with pure water by 100 c. c. neutral solution of Ammonium Citrate sp. gr. 1.09 in 30 minutes at 45° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" Phosphoric Acid.

TRADE VALUES OF SUPERPHOSPHATES AND MIXED GOODS.

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These values are applied to the valuation of superphosphates and all mixed goods as follows:

It is assumed that the *nitrogen* of these goods has for its source such materials as ammonia salts, nitrates, dried blood, ground fish, or nitrogenous substances of equally good quality, and it is valued at 17½ cents a pound.

The *insoluble phosphoric* acid of mixed fertilizers is considered as coming entirely from bone, and not from South Carolina rock, and is reckoned at three cents per pound.

The *potash* is valued at the price of that ingredient in kainite and the muriate, that is at four and one-fourth cents per pound.

The valuation of a fertilizer is obtained by multiplying the percentages of the several ingredients by twenty (which gives the pounds per ton), and these products by the prices per pound. The sum of the several final products is the market value of the fertilizing ingredients in one ton.

These estimated values should be studied in the light of the previous explanations. It will probably rarely happen in this State that a mixed fertilizer can be sold near the point of consumption as low as the station valuation, the excess of cost representing certain expenses previously enumerated. The station valuations give the consumers a fairly accurate basis for estimating the relative cost of plant food in the various brands of fertilizers, and will help the farmer to determine whether he can in any way profitably change his method of buying fertilizing ingredients. A caution should be uttered, however, against making too close an application of the station valuations, as a difference of a few cents, or even a dollar, on a ton between two brands may have no real significance, but may be due to unavoidable errors of sampling and analysis, that render it impossible to determine to the utmost exactness the composition of the entire bulk of material that is sold.

The laboratory methods used are essentially those agreed upon by the Association of Official Agricultural Chemists.

1. Nitrogen was determined by the absolute method with copper oxide and by the method of Kjeldahl.

2. Phosphoric acid was weighed as magnesium pyrophosphate after separation by molybdic acid.

3. Potash was precipitated with platinum bichloride, after separation by the method of Lindo, as modified by Gladding.

Comparative Value of Fertilizers Licensed in 1886 and 1887.

Of the thirty-six brands of commercial fertilizers sold in the State during the years 1886 and 1887, seventeen standard brands have been selected for a comparison between the character of the goods sold under these brands in each of the two years. Only those brands were selected which have been sold in the State during both of the years, and the Common Sense Fertilizers are not included, as their valuation falls far below their selling price.

Average Composition in 1886.

Name of fertilizing ingredient.	Pounds in a hundred.	Pounds in a ton.	Price per pound.	Valuation at 1886 prices.
Nitrogen	2.76	55	×18	$ 9.90
Soluble Phosphoric Acid	7.71	154	× 8	12.32
Reverted Phosphoric Acid	1.75	35	× 7½	2.63
Insoluble Phosphoric Acid	1.53	31	× 3	.93
Available Phosphoric Acid	9.46	189		
Total Phosphoric Acid	10.99	220		
Potash	2.61	52	× 4¼	2.21
Total valuation				$27.99

AVERAGE COMPOSITION IN 1887.

Name of fertilizing ingredient.	Pounds in a hundred.	Pounds in a ton.	Price per pound.	Valuation at 1887 prices.
Nitrogen	2.94	59	×17½	$10.33
Soluble Phosphoric Acid	6.69	133	× 8	10.64
Reverted Phosphoric Acid	2.50	50	× 7½	3.75
Insoluble Phosphoric Acid	1.94	39	× 3	1.17
Available Phosphoric Acid	9.19	184		
Total Phosphoric Acid	11.13	223		
Potash	2.77	55	× 4¼	2.34
Total valuation				$28.23

From these tables it will be seen that the quality of the fertilizers sold has slightly improved, the average valuation in 1886 being $27.99, while in 1887 it is $28.23, an increase of $0.24 or one per cent. During the year the retail price has fallen about a dollar a ton, the average selling price in 1886 being thirty-eight dollars a ton, against thirty-seven dollars a ton in 1887. The farmer has therefore made a total gain of $1.24 per ton, or about 5 per cent.

LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Manufacturer.	Dealer.	Sampled at
1	1	Soluble Pacific Guano	Glidden & Curtis, Boston, Mass.	L. J. Bolster.	Barre.
	2			Jones & Isham.	Burlington.
	3			Blake & Bradley.	Swanton.
	4			E. Davis.	Rutland.
	5			W. Wilder & Son.	St. Johnsbury.
2	1	Bradley's X. L. Superphosphate	Bradley Fertilizer Co., Boston, Mass.	E. C. Howard & Co.	Windsor.
	2			W. W. Park.	Montpelier.
	3			L. F. Terrill & Son	Underhill.
3	1	Bradley's Potato Manure	Bradley Fertilizer Co., Boston, Mass.	Hilton & Stevens.	Richmond.
	2			L. D. Nute.	Marshfield.
	3			W. C. Landon.	Rutland.
	4			J. P. Davis.	Northfield.
4	1	Bradley's B. D. Sea Fowl Guano	Bradley Fertilizer Co., Boston, Mass.	Hilton & Stevens.	Richmond.
	2			W. C. Landon.	Rutland.
	3			L. H. Warren.	Hardwick.

ANALYSES OF LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Nitrogen.	Phosphoric Acid.					Potash.
				Soluble in Water.	Soluble in Ammonium Citrate. "Reverted."	Insoluble.	Available.	Total.	
1	1	Soluble Pacific Guano	2.57	6.05	2.84	3.24	8.89	12.13	2.29
	2	..	2.60	6.05	3.44	4.17	9.49	13.66	2.75
	3		2.50	6.03	2.62	2.97	8.65	11.62	1.72
	4		2.43	4.86	3.57	2.62	8.43	11.05	2.22
	5		2 29	4.64	3.67	3.42	8.31	11.73	2.51
2	1	Bradley's X. L. Superphosphate	2.75	7.39	2.74	2.61	10.13	12.74	1.93
	2		2.73	6.90	3.31	2.57	10.21	12.78	2.06
	3		2.74	6.78	2.40	2.87	9.18	12.05	1.83
3	1	Bradley's Potato Manure	3.05	6.14	1.51	2.55	7.65	10.20	5.53
	2		3.53	5.98	.66	2.55	6.64	9.19	5.42
	3		3.14	5.86	2.59	.97	8.45	9.42	5.18
	4		3.50	4.86	2.16	2.56	7.02	9.58	5.34
4	1	Bradley's B. D. Sea Fowl Guano	2.65	7.41	2.39	2.32	9.80	12.12	2.31
	2		3.01	6.75	2.80	2.42	9.55	11.97	2.33
	3		2.47	7.41	1.87	2.11	9.28	11.39	2.23

LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Manufacturer.	Dealer.	Sampled at
6	1	Cumberland Superphosphate.....	Cumberland Bone Co., Portland, Me.	E. Kimball.	Northfield.
	2	.....		C. S. Davis.	Bethel.
	3	.....	.....	H. M. Wires.	W. Randolph.
7	1	E. Frank Coe's	E. Frank Coe,	Adams & Park.	Chester.
	2	High Grade Superphosphate.	New York City.	I. R. Warren.	Saxton's River.
	3	.....	.....	I. R. Warren.	Saxton's River.
8	1	Standard Fertilizer.....	Standard Fertilizer Co., Boston, Mass.	J. W. Hayes.	Burlington.
	2	.....		W. B. Douglas.	Williston.
	3	.....	.....	S. M. Flint.	Bethel.
	4	.....	.....	G. W. Bonett.	St. Johnsbury.
	5	.....	.....	E. Kimball.	Northfield.
9	1	Standard Guano.....	Standard Fertilizer Co., Boston, Mass.	J. W. Hayes.	Burlington.
	2	.....		W. B. Douglas.	Williston.
	3	.....	.....	J. C. Wheeler.	Brandon.
	4	.....	.....	G. W. Bonett.	St. Johnsbury.

ANALYSES OF LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Nitrogen.	Phosphoric Acid.					Potash.
				Soluble in Water.	Soluble in Ammonium Citrate, "Reverted."	Insoluble.	Available.	Total.	
6	1	Cumberland Superphosphate	4.38	4.35	1.63	5.60	5.98	11.58	4.50
	2		2.46	6.46	1.89	6.49	8.35	14 84	3.66
	3		2.48	5.63	2.49	4.90	8.12	13.02	3.49
7	1	E. Frank Coe's	2.10	7.45	3.10	2.27	10.55	12.82	1.99
	2	High Grade Superphosphate.	2.20	7.96	2.10	2.30	10.06	12.36	1.99
	3		2.27	8.03	2.42	1.78	10.45	12.23	1.92
8	1	Standard Fertilizer	2.87	6.70	3.12	1.92	9.82	11.74	2.08
	2		2.96	6.81	3.24	2.28	10.05	12.33	2.19
	3		2.13	5.05	3.69	3.67	8.74	12.41	2.19
	4		2.15	5.94	2.90	3.63	8.84	12.47	2.30
	5		1.76	4.73	3.23	4.13	7.96	12.09	2.30
9	1	Standard Guano	1.30	3.59	3.41	4.50	7.00	11.50	2.26
	2		1.21	2.33	4.57	4.58	6.90	11.48	2.21
	3		1.36	2.37	4.06	5.24	6.43	11.67	2 34
	4		.80	1.62	4.73	4.78	6.35	11.13	2.31

LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Manufacturer.	Dealer.	Sampled at
10	1	Bowker's Stockbridge Manures.....	Bowker Fertilizer Co., Boston, Mass.	E. L. Bass.	W. Randolph.
	2	.....		B. W. Green.	Morrisville.
	3	.....	.....	S. N. Bates.	Hardwick.
	4	.....	.....	Steven Morse.	Danville.
	5	.....	.....	Steven Morse.	Danville.
11	1	Bowker's Hill and Drill Phosphate.	Bowker Fertilizer Co., Boston, Mass.	T. P. Bartlett.	Plainfield.
	2	.....		W. B. McElroy.	Middlesex.
	3	.....	.....	E. L. Bass.	W. Randolph.
	4	.....	.....	B. W. Green.	Morrisville.
	5	.....	.....	S. N. Bates.	Hardwick.
12	1	Buffalo Ammoniated Bone Superphosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	R. M. Conant.	Richmond.
	2			Stone & Son.	Swanton.
	3	.....		J. R. George.	Barre.
	4	.....	.....	Martin Barber.	Waterbury.

ANALYSES OF LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Nitrogen.	Phosphoric Acid.					Potash.
				Soluble in Water.	Soluble in Ammonium Citrate. "Reverted."	Insoluble.	Available.	Total.	
10	1	Bowker's Stockbridge Manures..... ..	6.10	6.73	.74	.74	7.47	8.21	2.88
	2	....	5.78	4.89	2.72	.83	7.61	8.44	2.81
	3	....	5.28	5.09	1.81	1.01	6.90	7.91	2.87
	4	....	3.60	6.27	2.10	1.97	8.37	10.34	3.13
	5	....	3.58	6.63	2.62	1.66	9.25	10.91	3.04
11	1	Bowker's Hill and Drill Phosphate.....	2.74	7.93	1.79	1.22	9.72	10.94	1.53
	2	....	2.90	8.20	2.26	1.13	10.46	11.59	1.27
	3	.....	3.09	6.68	4.13	1.41	10.81	12.22	1.66
	4	....	3.02	6.07	4.98	1.50	10.99	12.49	1.36
	5	.. ..	2.83	8.03	1.94	2.09	9.97	12.06	1.11
12	1	Buffalo Ammoniated Bone	3.09	7.33	2.80	1.77	10.13	11.90	1.43
	2	Superphosphate.	3.36	7.64	2.20	1.26	9.84	11.10	2.03
	3	....	3.24	7.04	2.80	1.51	9.84	11.35	1.61
	4	....							

LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Manufacturer.	Dealer.	Sampled at
13	1	Buffalo Potato, Hop and Tobacco Phosphate.	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	R. M. Conant.	Richmond.
	2			Edwin Morse.	Bethel.
	3			S. P. Curtis.	Rutland.
	4			Martin Barber.	Waterbury.
14	1	Buffalo Special Superphosphate.	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Martin Barber.	Waterbury.
	2			J. R. George.	Barre.
	3			Martin Barber.	Waterbury.
15	1	Bay State Bone Superphosphate.	J. A. Tucker, Boston, Mass.	J. G. Bates.	Hartland.
	2			J. G. Bates.	Hartland.
	3			J. G. Bates.	Hartland.
16	1	Bay State Fertilizer.	Clark's Cove Guano Co., New Bedford, Mass.	T. P. Bartlett.	Plainfield.
	2			J. P. Northrup.	Brandon.
	3			A. H. McLeod & Co.	St. Johnsbury.
17	1	Homestead Superphosphate.	Michigan Carbon Works, Detroit, Mich.	A. G. Pierce.	Burlington.
	2			A. G. Pierce.	Burlington.
	3			A. G. Pierce.	Burlington.

ANALYSES OF LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Nitrogen.	Phosphoric Acid.					Potash.
				Soluble in Water.	Soluble in Ammonium Citrate. "Reverted."	Insoluble.	Available.	Total.	
13	1	Buffalo Potato, Hop and Tobacco Phosphate...	2.22	7 36	1.53	1.29	8.89	10.18	4.54
	2	....	2.23	7.53	1.57	1.26	9.10	10.36	4.25
	3	....	2.33	7.04	1.07	2.66	9.70	10.77	3.96
	4	....							
14	1	Buffalo Special Superphosphate.....	1.96	7.00	2.72	.97	9.72	10.69	3.41
	2	.....	1.99	6.65	2.81	1.22	9.46	10.68	1.54
	3	.....	1.96	7.23	2.85	1.15	10.08	11.23	3.08
15	1	Tucker's Bay State Bone Superphosphate.....	2.94	6.95	1.50	2.94	8.45	11.39	3.22
	2	....	2.87	6.29	1.95	3.12	8.24	11.36	3.42
	3	.....	2.83	6.82	1.22	3.06	8.04	11.10	3.19
16	1	Bay State Fertilizer.....	2.69	8.55	1.21	1.71	9.76	11.41	2.79
	2	....	2.69	8.07	1.83	2.76	9.90	12.68	3.24
	3	....	2.60	8.49	2.14	2.06	10.63	12.70	2.93
17	1	Homestead Superphosphate.....	2.24	5.28	2.05	1.38	7.33	8.71	2.02
	2	.....	2.31	5.72	3.06	1.02	8.78	9.80	1.85
	3	....	2.41	5.54	2.73	.92	8.27	9.19	1.81

LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Manufacturer.	Dealer.	Sampled at
18	1	Americus Ammoniated Bone Superphosphate.	Williams and Clark Co., New York City.	W. C. Whitney.	Newport.
	2			E. Carlton.	Barre.
	3			J. Bissonnett.	Jericho.
19	1	Americus Special Potato Manure...	Williams and Clark Co., New York City.	J. Bissonnett.	Jericho.
	2			H. D. Bryant.	Morrisville.
	3			D. L. Fuller & Son.	Montpelier.
20	1	Cleveland Superphosphate.....	Cleveland Dryer Co., Cleveland, O.	Kidder & Ryan.	Plainfield.
	2			H. P. Sanford & Co.	W. Randolph.
	3			S. Harris.	Morrisville.
21	1	Quinnipiac Potato Manure.....	Quinnipiac Co., New London, Conn.	C. W. Howe.	Richmond.
	2			Lane & Davis.	Newport.
	3			J. H. Chatterton.	Rutland,
	4			S. Harris.	Morrisville.
22	1	Quinnipiac Phosphate...	Quinnipiac Co., New London, Conn.	C. W. Howe.	Richmond.
	2			Lane & Davis.	Newport.
	3			Wm. Cooley.	Waterbury.
	4			B. A. Clark.	Brattleboro.

ANALYSES OF LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Nitrogen.	Phosphoric Acid.					Potash.
				Soluble in Water.	Soluble in Ammonium Citrate. "Revert'd."	Insoluble.	Available.	Total.	
18	1	Americus Ammoniated Bone Superphosphate..	2.69	7.96	2.40	1.09	10.36	11.45	3.09
	2	.....	2.79	6.31	3.63	.89	9.94	10.83	2.94
	3	.....	2.61	7.14	3.10	.84	10.24	11.08	3.00
19	1	Americus Special Potato Manure.....	3.95	5.18	2.35	.34	7.53	7.87	8.34
	2	.....	4.01	5.19	1.24	.74	6.45	7.19	8.42
	3	.....	3.26	5.08	1.24	.88	6.32	7.20	8.64
20	1	Cleveland Superphosphate.....	2.48	8.51	1.66	2.01	10.17	12.18	3.52
	2	.....	2.56	8.33	2.27	2.92	10.60	13.52	2.26
	3	.....	2.50	7.51	2.39	2.61	9.90	12.51	2.62
21	1	Quinnipiac Potato Manure.....	3.99	4.31	1.92	.69	6.23	6.92	6 46
	2	.....	4.34	4.13	2.29	.51	6.42	6.93	6.13
	3	.....	4.41	4.34	1.93	.78	6.27	7.05	6.26
	4	.....	4.03	3.10	3.07	.90	6.17	7.07	6.27
22	1	Quinnipiac Phosphate.....	3.50	6.14	4.38	3.51	10.52	14.03	2.21
	2	.....	3.44	7.79	2.61	.29	10.40	10.69	2.46
	3	.....	3.41	8.10	2.11	.55	10.21	11.76	2.44
	4	.....							

LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Manufacturer.	Dealer.	Sampled at
23	1	Quinnipiac Pine Island Phosphate.	Quinnipiac Co., New London, Conn.	Wm. Cooley.	Waterbury.
	2	.....		J. H. Chatterton.	Rutland.
	3	.....	.....	S. Harris.	Morrisville.
24	1	Common Sense Fertilizer No. 1....	Common Sense Fertilizer Co., Boston, Mass.	J. H. Ainsworth.	Hardwick.
	2	.....		John Trow.	Barre.
	3	.....	.....	J. H. Ainsworth.	Hardwiek.
25	1	Common Sense Fertilizer No. 2....	Common Sense Fertilizer Co., Boston, Mass.	J. H. Ainsworth.	Hardwick.
	2	.....		J. M. Temple.	Northfield.
	3	.....	.....	John Trow.	Barre.
26	1	Common Sense Special Soluble Fertilizer No. 22.	Common Sense Fertilizer Co., Boston, Mass.	J. M. Temple.	Northfield.
	2			J. M. Temple.	Northfield.
	3	.....	.....	J. M. Temple.	Northfield.
27	1	Orient Complete Manure.....	Orient Guano M'f'g Co. Orient, L. I.	J. L. Buttolph.	Middlebury.
	2	.....		D. L. Fuller & Son.	Montpelier.
	3	.....	.....	R. L. Clark.	Barre.

ANALYSES OF LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Nitrogen.	Phosphoric Acid.					Potash.
				Soluble in Water.	Soluble in Ammonium Citrate. "Reverted."	Insoluble.	Available.	Total.	
23	1	Quinnipiac Pine Island Phosphate.....	3.35	8.05	1.35	.96	9.40	10.36	2.50
	2	.....	3.31	8.43	2.14	.41	10.57	10.98	2.47
	3	.....	3.04	3.93	5.85	1.76	9.78	11.54	1.77
24	1	Common Sense Fertilizer No. 1.....	2.17	.....	4.12	1.89	4.12	6.01	3.94
	2	.....	2.17	.....	4.44	1.89	4.44	6.33	3.98
	3	.....	2.10	.....	4.24	1.98	4.24	6.22	4.10
25	1	Common Sense Fertilizer No. 2.....	2.48	.26	4.91	2.75	5.17	7.92	3.47
	2	.....	3.14	.....	3.82	2.70	3.82	6.52	2.68
	3	.....	2.86	.....	4.83	4.50	4.83	9.33	2.70
26	1	Common Sense Special Soluble	3.01	.....	7.94	3.83	7.94	11.77	2.27
	2	Fertilizer No. 22.	2.97	.....	6.36	4.80	6.36	11.16	.92
	3	.....	3.04	.....	7.30	4.16	7.30	11.46	2.35
27	1	Orient Complete Manure.....	2.27	6.06	1.55	1.19	7.61	8.80	1.46
	2	.....	1.78	6.20	1.90	1.28	8.10	9.38	1.33
	3	.....	1.83	6.49	1.95	1.37	8.44	9.81	1.41

LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Manufacturer.	Dealer.	Sampled at
28	1	Bowker's Potato Phosphate.....	Bowker Fertilizer Co., Boston, Mass.	E. L. Bass.	W. Randolph.
	2	.....		B. W. Green.	Morrisville.
	3	.....	.....	S. M. Bates.	Hardwick.
	4	.....	.....	De Witt Davis.	Chester.
29	1	Liebig's Ammoniated Superphosphate.	Flamingo Guano Co., Baltimore, Md.	G. W. Parmenter.	Montpelier.
	2			G. C. Stebbins.	St. Johnsbury.
	3	.....	.....	G. C. Stebbins.	St. Johnsbury.
30	1	Bowker's Ammoniated Dissolved Bone.	Bowker Fertilizer Co., Boston, Mass.	B. W. Green.	Morrisville.
	2			S. M. Bates.	Hardwick.
	3	.....	.....	De Witt Davis.	Chester.
31	1	Cumberland Seeding Down Fertilizer.	Cumberland Bone Co., Portland, Me.	C. C. Miller.	Lyndonville.
	2			C. C. Miller.	Lyndonville.
	3	.....	.....	C. C. Miller.	Lyndonville.

ANALYSES OF LICENSED FERTILIZERS SAMPLED BY STATION.

Number of license.	Number of sample.	Brand.	Nitrogen.	Phosphoric Acid.					Potash.
				Soluble in Water.	Soluble in Ammonium Citrate. "Reverted."	Insoluble.	Available.	Total.	
28	1	Bowker's Potato Phosphate	3.23	7.69	2.31	3.15	10.00	13.15	2.46
	2		2.90	5.81	4.50	2.74	10.31	13.05	3.47
	3		2.90	6.65	4.12	1.91	10.77	12.68	2.86
	4								
29	1	Liebig's Ammoniated Superphosphate	1.73	1.50	7.34	4.46	8.84	13.30	.88
	2		1.89	.73	5.68	6.84	6.41	13.25	.87
	3		1.75	.75	5.50	6.79	6.25	13.04	.91
30	1	Bowker's Ammoniated Dissolved Bone	2.56	7.80	3.01	1.38	10.81	12.19	2.19
	2		2.55	7.41	2.63	1.59	10.04	11.63	1.60
	3		2.42	7.55	3.15	1.54	10.70	12.24	1.42
31	1	Cumberland Seeding Down Fertilizer	1.89	1.94	11.11	8.49	13.05	21.54	1.13
	2		1.96	1.88	10.11	9.54	11.94	21.48	.97
	3		2.06	1.61	12.19	7.99	13.80	21.79	1.15

AVERAGE COMPOSITION OF LICENSED FERTILIZERS.

The tables which immediately follow give the average composition of the different brands as calculated from the analyses just given of the separate samples. The selling prices noted, represent in most instances the rate at which single packages, and not ton lots, are sold. The comparative money values as calculated by the Station in the manner previously explained, have much more significance than the excess of selling price over valuation, because the selling price varies in some instances according to the quantity of fertilizer sold, conditions of payment, location, etc.

Number of license.	Brand.	Nitrogen.		Phosphoric Acid.										Potash.		Selling price for 2000 lbs.	Valuation of 2000 lbs. at station prices.	Percentage difference between selling price and val.
				Soluble.		Reverted.		Insoluble.		Available.		Total.						
		Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.			
1	Soluble Pacific Guano.....	2.48	2.00	5.53	6.50	3.23	1.50	3.28	2.00	8.76	.....	12.04	.....	2.30	2.00	36.00	26.32	37
2	Bradley's X. L. Superphos.	2.74	2.50	7.02	7.00	2.82	2.00	2.68	2.00	9.84	9.00	12.52	11.00	1.94	2.00	38.00	28.31	34
3	Bradley's Potato Manure..	3.30	2.68	5.71	5.00	1.73	1.00	2.16	2.00	7.44	6.00	9.60	.....	5.37	6.00	38.00	29.21	30
4	Bradley's B. D. S. F. Guo.	2.71	2 50	7.19	7.00	2.36	2.00	2.28	2.00	9.55	9.00	11.83	11.00	2.29	2.00	36.00	27.84	29
6	Cumberland Superphos....	3.11	2.00	5.48	5.00	2.01	1.50	5.66	2.00	7.49	8.00	13 15	11.00	3.68	2.00	38.00	29.19	30
7	E. Frank Coe's H. G. Su..	2.19	2.00	7.81	7.00	2.54	2.00	2.12	2.00	10.35	9 00	12.47	11.00	1.97	1 75	38 00	26.91	41
8	Standard Fertilizer.....	2.37	2 25	5.85	7.00	3.24	1.00	3.13	2.00	9.08	8.50	12.21	10.50	2.21	2.00	37.00	26 27	41
9	Standard Guano.....	1.17	1.00	2.48	7.00	4.20	1.00	4.77	2 00	6.68	8.00	11.45	10.00	2.28	2.00	35.00	19.16	82
10	Bowker's St'ckb'ge Ma'ure.	4.87	4.40	5.92	....	2.00	....	1.24	....	7.92	5.80	9.16	7.00	2.95	3.30	42.00	32.77	28
11	Bowker's H. and D. Phos..	2.92	2 50	7.38	8.00	3.01	2.00	1.47	1.00	10.39	10.00	11.86	11.00	1.39	2.00	38.00	28.61	33
12	Buffalo Am. Bone Super...	3.22	2.90	7.26	6.00	2.64	2.00	1.44	1.00	9.90	8.00	11.34	9.00	1.69	1.00	38.00	29.16	30
13	Buffalo Po. H. and T. Phos.	2.28	2.00	7.27	6.00	2.04	2 00	1.18	1.00	9.31	8.00	10.49	9.00	4.21	3.50	36.00	26.94	34
14	Buffalo Special Superphos.	1.97	1.65	6.96	6.00	2.76	2.00	1.11	1.00	9.72	6.00	10.83	9.00	2 68	1.00	35.00	25.11	39
15	Tucker's Bay State B'ne Su.	2.88	.....	6.69	....	1.55	....	3.04	....	8.24	.....	11.28	.. ...	3 28	.....	35.00	27.72	27
16	Bay State Fertilizer.....	2.66	.....	8.37	....	1.71	....	2.18	.....	10.08	.....	12.26	.....	2.99	.....	38.00	29.11	30

AVERAGE COMPOSITION OF LICENSED FERTILIZERS.

(4)

Number of license.	Brand.	Nitrogen.		Phosphoric Acid.										Potash.		Selling price for 2000 lbs.	Valuation of 2000 lbs. at station prices.	Percentage difference between selling price and val.
				Soluble.		Reverted.		Insoluble.		Available.		Total.						
		Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.			
17	Homestead Superphosphate	2 32	1.85	5.51	7.00	2.58	....	1.11	.50	8.09	8.00	9.20	.....	1.89	1.50	38.00	23.08	64
18	Americus Ammoniated Bone Super	2.70	2.50	7.14	7.00	2.74	3.00	1.24	1.00	9.88	.....	11.12	11.00	3.01	2.00	38.00	28.28	34
19	Americus Special Potato Manure	3.74	3.00	5.15	5.00	1.62	1.00	.65	....	6.77	.....	7.42	7.00	8.47	8.00	45.00	31.35	44
20	Cleveland Superphosphate	2.51	2.05	8.12	6.00	2.11	2.00	2.51	2.00	10.23	8.00	12.74	10.00	2.80	3.00	38.00	28.82	32
21	Quinnipiac Potato Manure	4.19	3.25	3.97	3.00	2.32	2.00	.70	1.00	6.29	.....	6.99	.....	6.28	6.00	38.00	30.25	26
22	Quinnipiac Phosphate	3.48	2.75	7.48	6.00	2.99	3.00	1.23	1.00	10.47	.....	11.70	10.00	2.26	2.00	38.00	31.33	21
23	Quinnipiac Pine Island Phosphate	3.23	2.00	6.80	6.00	3.12	3.00	1.04	1.00	9.92	.....	10.96	.....	2.25	1.00	36.00	29.40	22
24	Common Sense Fertilizer No. 1	2.15	2.00	....	....	4.27	....	1.92	...	4.27	.....	6.19	3.00	4.01	2.5	27.50	18.49	49
25	Common Sense Fertilizer No. 2	2.95	2.00	.09	....	4.51	....	3.32	....	4.60	.....	7.92	4.00	2.95	3.00	35.00	21.31	64
26	Common Sense Special Sol. Fer. No. 22.	3.01	2.00	....	....	7.22	....	4.20	....	7.22	.....	11.42	9.00	1.85	1.00	35.00	25.46	38
27	Orient Complete Manure	1.96	1.77	6.25	7.00	1.80	....	1.28	2.00	8.05	8 00	9.33	.....	1.37	1.00	35.00	21.49	63
28	Bowker's Potato Phosphate	3.01	2.50	6.54	....	3.65	....	2.51	....	10.19	8.00	12.70	10.00	3.18	4.00	38.00	30.67	24
29	Liebig's Ammoniated Superphosphate	1.79	1.60	.99	....	6.18	....	6.03	3.00	7.17	8.00	13.20	.....	.92	1.00	36.00	21.52	67
30	Bowker's Ammoniated Dissolved Bone	2.51	1.83	7.59	7.00	2.93	2.00	1.50	2.00	10.52	9.33	12.02	10.33	1.74	1.66	36.00	27.70	30
31	Cumberland Seeding Down Fertilizer	1.97	1.65	1.79	...	11.14	....	8.67	....	12.93	.....	21.60	18.00	1.08	1.00	30.00	32.59	8*

*Above selling price.

THE AVAILABILITY OF THE NITROGEN IN COMMERCIAL FERTILIZERS.

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It has often been claimed by farmers that the chemist in his analysis of commercial fertilizers, does not tell them enough about their composition. They say that the chemist gives them the commercial value only, while the agricultural value, which is the important thing to the farmer, is not shown.

With regard to phosphoric acid and potash, the present methods of chemical analysis are quite satisfactory and furnish a reliable basis for a judgment as to the agricultural value of these ingredients. But in the case of nitrogen, the complaint of the farmer has some foundation in fact. It is a fact that a fertilizer can be manufactured which shall analyze high in nitrogen and yet have very little value as a fertilizer. The ordinary method of analysis, such as is required by the State law, and has formerly been in use in this State and is commonly used in many other States, gives the total amount of nitrogen in the fertilizer without showing whether or not the nitrogen is in a form available for plant food. The principal use of commercial fertilizers in Vermont is to give an early and vigorous start to hoed crops. It is important then for Vermont farmers to know how much of the nitrogen in each of the fertilizers sold in the State is in such a form that it is available for this rapid growth.

Nitrogen is put into commercial fertilizers in three forms as nitrogen of *ammonia* salts, nitrogen of *nitrates* and nitrogen in combination with animal or vegetable matter, commonly called *organic nitrogen.* All ammonia salts and nitrates are soluble in water and hence immediately available to the plant. With organic nitrogen the case is quite different. The principal sources of organic nitrogen are dried blood, fish scrap, bone meal, slaughter-house refuse, horn and hoof meal and leather waste. These materials have a very different agricultural value; dried

blood, for instance, decays rapidly in the soil and yields its nitrogen to the crop, while hoof and horn meal and leather waste are almost worthless, resisting for a long time the process of decay.

The present investigation was undertaken to determine whether any of these poorer materials had been used in the manufacture of the fertilizers offered our farmers, and at the same time determine how much of the nitrogen present was immediately available for the use of the plant. The method of analysis used was that of digesting the fertilizer for a certain time in a solution of pepsin and determining the amount of the organic nitrogen dissolved by this solution. Many experiments have shown that dried blood is very largely dissolved by this solution and that the larger part of the nitrogen of fish scrap, bone meal and slaughter-house refuse is also dissolved, while hoof and horn meal and leather waste are scarcely acted upon. This furnishes a ready method therefore for separating these two classes of organic nitrogenous material.

Each brand of fertilizer, licensed for sale in the State during the year 1887, has been thus examined and the results are given in the subjoined table. By reference to this, it will be seen that the average solubility of the organic nitrogen is at least seventy per cent, showing that in the great majority of the fertilizers the best class of materials has been used. All the nitrogen from ammonia salts and from nitrates and all the organic nitrogen soluble in pepsin solution, may be considered as immediately available, and the sum of these three, *i. e.* columns 2, 3 and 5, forms column 8. Column 6 is found by dividing column 5 by column 4 and column 7 by dividing column 8 by column 1.

The analytical method used was as follows: Equal quantities of at least three samples of each fertilizer were mixed and well pulverized. The pepsin solution contained 5 grams of "Golden Scale Pepsin" to the litre, and 0.2 per cent of muriatic acid. Two grams of fertilizer was digested with 200 c. c. of above pepsin solution at a temperature of 104° F.; after two hours' digestion, 2 c. c. of a 10 per cent solution of muriatic acid was added; every three hours this was repeated, so that at the end of twenty-four hours' digestion, the quantity of muriatic acid present amounted to one per cent. The heating was not con-

tinuous, but the solution was allowed to cool at night, so that to obtain the twenty-four hours of actual heating, required parts of three days with two nights of cooling. The solution was then filtered, the residue washed thoroughly with water and dried. The amount of undissolved nitrogenous matter in this residue was determined by the Kjeldahl method.

No. of License.	BRAND OF FERTILIZER.	Total Nitrogen. 1	Nitrogen from Ammonia Salts. 2	Nitrogen from Nitrates. 3	Organic Nitrogen. 4	Organic Nitrogen soluble in Pepsin solution. 5	Per cent of Organic Nitrogen soluble in Pepsin solution. 6	Per cent of total Nitrogen immediately available. 7	Whole amount of Nitrogen immediately available. 8
1	Soluble Pacific Guano	2.48	0.32	......	2.16	1.59	74	77	1.91
2	Bradley's X. L. Superphosphate	2.74	0.23	0.37	2.14	1.76	82	86	2.36
3	Bradley's Potato Manure	3.30	0.11	0.42	2.77	2.30	83	86	2.83
4	Bradley's B. D. Sea Fowl Guano	2.71	0.06	0.48	2.17	1.66	77	81	2.20
6	Cumberland Superphosphate	3.11	0.15	0.74	2.22	1.49	67	76	2.38
7	E. Frank Coe's High Grade Superphosphate	2.19	0.55	......	1.64	1.27	78	83	1.82
8	Standard Fertilizer	2.37	0.51	......	1.86	1.31	70	77	1.82
9	Standard Guano	1.17	0.27	......	0.90	0.71	79	84	0.98
10	Bowker's Stockbridge Manure	4.87	1.68	......	3.19	2.37	74	83	4.05
11	Bowker's Hill and Drill Phosphate	2.92	0.49	......	2.43	1.85	76	80	2.34
12	Buffalo Ammoniated Bone Superphosphate	3.22	0.12	......	3.10	2.04	66	67	2.16
13	Buffalo Potato, Hop and Tobacco Phosphate	2.28	0.09	......	2.19	1.51	69	70	1.60
14	Buffalo Special Superphosphate	1.97	0.08	......	1.89	1.31	69	70	1.40
15	Tucker's Bay State Bone Superphosphate	2.88	0.10	......	2.78	1.26	45	47	1.36
16	Bay State Fertilizer	2.66	0.88	......	1.78	1.24	70	79	2.12

No. of License.	Brand of Fertilizer.	Total Nitrogen. 1	Nitrogen from Ammonia Salts. 2	Nitrogen from Nitrates. 3	Organic Nitrogen. 4	Organic Nitrogen soluble in Pepsin solution. 5	Per cent of Organic Nitrogen, soluble in Pepsin solution. 6	Per cent of total Nitrogen immediately available. 7	Whole amount of Nitrogen immediately available. 8
17	Homestead Superphosphate	2.32	0.26	......	2.06	1.22	59	64	1.48
18	Americus Ammoniated Bone Superphosphate	2.70	0.93	......	1.77	1.25	71	81	2.18
19	Americus Special Potato Fertilizer	3.74	1.99	......	1.75	1.33	76	89	3.32
20	Cleveland Superphosphate	2.51	0.45	......	2.06	1.56	76	80	2.01
21	Quinnipiac Potato Manure	4.19	0.47	0.79	2.93	2.07	71	80	3.33
22	Quinnipiac Phosphate	3.48	0.29	0.48	2.71	1.70	63	71	2.47
23	Pine Island Phosphate	3.23	0.23	0.48	2.52	1.52	60	69	2.23
24	Common Sense Fertilizer, No. 1	2.15	0.71	0.36	1.08	0.35	32	66	1.42
25	Common Sense Fertilizer, No. 2	2.95	1.94	0.13	0.88	0.28	32	80	2.35
26	Common Sense Special Sol. Fertilizer, No. 22	3.01	0.99	0.14	1.88	1.29	69	84	2.52
27	Orient Complete Manure	1.96	0.27	......	1.69	1.13	67	71	1.40
28	Bowker's Potato Phosphate	3.01	1.34	......	1.67	0.77	46	70	2.11
29	Liebig's Ammoniated Bone Superphosphate	1.79	0.54	......	1.25	0.70	56	61	1.09
30	Bowker's Ammoniated Dissolved Bone	2.51	0.18	......	2.33	1.43	61	64	1.61
31	Cumberland Seeding Down Fertilizer	1.97	0.35	0.35	1.27	0.97	76	85	1.67

ANALYSES OF COMPLETE FERTILIZERS, NOT SAMPLED BY STATION.

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Under Sec. 4 of the law establishing the Experiment Station, any resident of the State can have analyzed free of charge a sample of a fertilizer he has purchased for his own use. There was some fear that this provision might flood the Station with more work than it could perform, but the fact that the first bulletin of fertilizer analyses was published before planting time, removed the motive for most of the special analyses, and but few samples, under this section have been received. The analysis of these is given below, in the order they were received at the Station.

AMERICUS AMMONIATED BONE SUPERPHOSPHATE,

Manufactured by Williams & Clark Co., New York City; sent by S. C. Drew, South Royalton, from stock on hand which had been manufactured in 1885.

	Guaranteed.	Found.
Nitrogen	2.50	2.24
Soluble Phosphoric Acid	7.00	4.17
Reverted Phosphoric Acid	3.00	5.89
Insoluble Phosphoric Acid	1.00	2.32
Available Phosphoric Acid	10.00	10.06
Total Phosphoric Acid	11.00	12.38
Potash	2.00	2.69

As was to be expected, much of the soluble phosphoric has changed to the "reverted" form, but as this form is of about equalagricultural value, the purchaser therefore would not suffer loss. Apparently there has also been an actual loss of some of the nitrogen.

STOCKBRIDGE MANURE FOR SEEDING DOWN,

Manufactured by Bowker Fertilizer Co., Boston, Mass.; sampled by Station's Agent at the request of E. L. Bass of West Randolph, from stock then in his possession.

	Guaranteed.	Found.
Nitrogen	2.50	3.01
Soluble Phosphoric Acid	2.50	6.76
Reverted Phosphoric Acid	.....	1.98
Insoluble Phosphoric Acid	.....	2.56
Available Phosphoric Acid	.....	8.74
Total Phosphoric Acid	14.00	11.30
Potash	4.00	5.36

STOCKBRIDGE MANURE FOR FRUIT TREES,

Manufactured by Bowker Fertilizer Co., Boston, Mass.; sampled by Station's Agent at the request of E. L. Bass of West Randolph, from stock then in his possession.

	Guaranteed.	Found.
Nitrogen	2.50	3.55
Soluble Phosphoric Acid	.....	5.04
Reverted Phosphoric Acid	.....	3.40
Insoluble Phosphoric Acid	.....	3.72
Available Phosphoric Acid	6.00	8.44
Total Phosphoric Acid	8.00	12.16
Potash	5.00	5.02

GREAT EASTERN POTATO SPECIAL,

Manufactured by Great Eastern Fertilizer Co., Rutland, Vt. Sample sent by Wheeler & Sheldon, Rutland, from stock of J. W. Cramton, Rutland.

	Guaranteed.	Found.
Nitrogen	2.00	1.94
Soluble Phosphoric Acid	6.00	5.18
Reverted Phosphoric Acid	2.00	2.98
Insoluble Phosphoric Acid	1.00	1.14
Available Phosphoric Acid	8.00	8.16
Total Phosphoric Acid	....	9.30
Potash	6.00	6.16

GREAT EASTERN GENERAL,

Manufactured by the Great Eastern Fertilizer Co., Rutland, Vt. Sample sent by Wheeler & Sheldon, Rutland, from stock of J. W. Cramton, Rutland.

	Guaranteed.	Found.
Nitrogen	3.00	3.11
Soluble Phosphoric Acid	6.00	4.07
Reverted Phosphoric Acid	2.00	3.75
Insoluble Phosphoric Acid	1.00	1.24
Available Phosphoric Acid	8.00	7.82
Total Phosphoric Acid	....	9.06
Potash	2.00	2.25

BONE MEAL FERTILIZER,

Made by Fertilizer Manufacturing Co., Fort Ann, N. Y. Sent by J. H. Chatterton, Rutland.

	Guaranteed.	Found.
Nitrogen	3.00	2.84
Soluble Phosphoric Acid	.....	.....
Reverted Phosphoric Acid	.....	7.35
Insoluble Phosphoric Acid	.....	4.07
Available Phosphoric Acid	.....	7.35
Total Phosphoric Acid	14.00	11.42
Potash	3.00	1.96

HILL AND DRILL PHOSPHATE,

Manufactured by Bowker Fertilizer Co., Boston, Mass.; sent by Chas. H. Dinsmore, Georgia Plain, from stock of A. D. Haseltine, Swanton.

	Guaranteed.	Found.
Nitrogen	2.50	2.76
Soluble Phosphoric Acid	8.00	7.41
Reverted Phosphoric Acid	1.00	1.99
Insoluble Phosphoric Acid	.....	1.28
Available Phosphoric Acid	.....	9.40
Total Phosphoric Acid	11.00	10.68
Potash	2.00	1.98

This sample was from goods that had lain over and were thought to have been damaged, but the analysis failed to show that any material loss had occurred.

BONE MEAL.

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The State Fertilizer law does not require that bone meal should be licensed and analyzed, but the Station has analyzed, free of charge, all the samples that have been sent to it, in order that the farmers might have some idea of the value of the material they were buying. The analysis is given of all samples received up to March 1, 1888. The Station can not, of course, certify to the correctness of the sampling in those cases where the samples have been sent by private individuals, but it has, in each case, required and received a written statement signed by the person sending the sample, describing its origin, and there is no reason for believing that any of the samples were not what they purported to be.

The system of valuation of bone meal is different from that used for superphosphates. It costs a good deal more to manufacture and grind bone to a fine state of division, than to produce a coarse-grained article; hence the fineness becomes an important element in estimating the comparative commercial value of different brands. The prices used in calculating the valuations are as follows, in cents per pound.

	Nitrogen.	Phosphoric Acid.
In fine bone, i. e., finer than 1-50 inch.....	16	7
In fine-medium bone, i. e., finer than 1-24 inch...	14	6
In medium bone, i. e., finer than 1-12 inch.....	12	5
In coarse-medium bone, i. e., finer than 1-16 inch.	10	4
In coarse bone, i. e,, coarser than 1-6 inch.....	8	3

DESCRIPTION OF SAMPLES OF BONE MEAL.

Station No.	Manufactured by	Sampled and Sent by
8	Buffalo Fertilizer Co., Buffalo, N. Y.	H. E. Colburn, Rutland.
10	Bowker Fertilizer Co., Boston, Mass	Chapin Leonard, Glover.
27	C. G. Stebbins, St. Johnsbury, Vt.	C. G. Stebbins, St. Johnsbury.
37	Valley Mill Co., Brattleboro, Vt	C. Q. Stebbins, Townshend.
51	Bowker Fertilizer Co., Boston, Mass	Station's Agent, West Randolph.
72	Williams & Clark Co., New York City	J. C. Giddings, Rutland.
118	Baugh & Son, Philadelphia, Pa.	Leslie Adams, Guilford.
124	Bradley Fertilizer Co., Boston, Mass.	Station's Agent, Johnson.
126	Fertilizer Manufacturing Co., Fort Ann, N. Y.	J. H. Chatterton, Rutland.
*187	A. R. Robertson, Winooski, Vt.	B. H. Porter, Burlington.
194	Armour & Co., Chicago, Ill.	Ingalls Bros., Lyndonville.
*195	L. B. Darling Fertilizer Co., Pawtucket, R. I.	Geo. Campbell's Sons, Westminster West.

*In Bulletin No. 6 of this Station, these names were by mistake transposed.

ANALYSIS OF SAMPLES OF BONE MEAL.

Station No.	Manufacturer.	Phosphoric Acid.	Nitrogen.	Finer than				Coarser than 1-6 inch.	Valuation per ton.		
				1-50 inch.	1-24 inch.	1-12 inch.	1-6 inch.		Phosphoric Acid.	Nitrogen.	Total.
8	Buffalo Fertilizer Co	24.06	4.19	56	28	16	....	...	$30.80	$12.40	$43.20
10	Bowker Fertilizer Co	17.24	3.26	38	26	28	8	....	20.46	9.04	29.50
27	C. G. Stebbins	19.08	4.06	13	33	36	18	....	20.65	10.41	31.06
37	Valley Mill Co	20.72	4.51	24	23	43	10	....	24.25	11.92	36.17
51	Bowker Fertilizer Co	19.36	3.42	42	32	14	12	...	23.23	9.47	32.70
72	Williams & Clark Co	19.03	4.12	53	24	17	6	....	23.74	11.56	35.30
118	Baugh & Son	20.60	3.95	55	42	3	....	....	26.86	11.88	38.74
124	Bradley Fertilizer Co	24.05	3.75	58	23	15	4	...	30.54	10.94	41.48
126	Fertilizer Manufacturing Co	9.80	3.20	26	17	20	23	14	10.15	7.91	18.06
187	A. R. Robertson	21.00	4.10	24	30	35	11	...	24.81	10.83	35.64
194	Armour & Co	25.30	3.43	38	40	22	....	....	31.16	9.80	40.96
195	L. B. Darling Fertilizer Co	25.65	2.48	29	49	17	5	....	29.47	6 96	36.43

ANALYSES OF MISCELLANEOUS FERTILIZING MATERIALS.

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In accordance with the spirit of law establishing the Station, i. e., that it was to be of as much benefit as possible to the farmers of the State, the Station has analyzed everything that was sent to it, that promised to have value as a source of plant food.

Ashes.

Station No. 9, was sent by T. P. Sawyer, origin not stated; No. 94, sent by W. V. Farr of Westminster, from a carload bought from Charles Stevens, Napanee, Can.; No. 119 was sampled by the Station's agent, from a carload collected in Montpelier and Barre, by C. S. Richmond of Northfield. The last sold at 28 cents per bushel of 40 quarts, which weighed in this sample 43 pounds. This would be $13 per ton. The selling price of No. 94 was "$12.50 per ton when dry." It will be noticed that there is a great difference in the quality of the different samples. It shows that those who expect to purchase large quantities of ashes should draw samples and have them analyzed by the Station, before closing the bargain.

	Station No. 9.	Station No. 94.	Station No. 119.
Moisture.....per cent.		24.26	
Total Phosphoric Acid..... " "	2.50	1.51	2.05
Potash, soluble in water..... " "	6.06	3.71	5.95
Potash, insoluble in water..... " "		1.21	1.52
Total Potash..... " "		4.92	7.47

It is not possible to give a valuation of ashes that will not be misleading, since they are valuable not only for the plant food they contain, but also for their mechanical and chemical action on the soil, and on the plant food it contains.

Muck.

Two samples of muck were forwarded to the Station by A. B. Carpenter, West Waterford, with this statement: "The muck bed is a basin of some five of six acres, and in its original state, it had no stream running in or out of it. By making a cut of from forty to fifty feet through a sandy and gravelly ridge, it is now drained some eight feet deep, so what was once a pond in spring, is now dry. There seem to be some hidden springs that circulate through the lower part of the bed and keep it continually wet. Water stands nearly all the year in the bottom of the ditch; in wet times it will run out through the drain. Sample No. 1 was taken near the bottom, subject to the circulation of the spring water, keeping it cold all summer. Sample No. 2 was taken about three feet from No. 1, with a foot or two from the top. Please state what should be added to adapt the muck more perfectly for vegetable growth."

An answer substantially as follows was made to Mr. Carpenter:

Your samples of muck analyze as follows:

	No. 1.	No. 2.
Moisture.. .....per cent.	84.71	77.34
Dry matter..... " "	15.29	22.66
Dry matter contained Nitrogen..... " "	1.54	2.71

Counting the nitrogen as worth 17 cents per pound, it makes each kind of muck worth in the condition it was when received:

No. 1, 4.71 lbs. nitrogen at 17 cents, $0.71 per ton.

No. 2, 12.28 lbs. nitrogen at 17 cents, $2.09 per ton.

When thoroughly dry they would be worth:

No. 1, 30.8 lbs. nitrogen at 17 cents, $5.24 per ton.

No. 2, 54.2 lbs. nitrogen at 17 cents, $9.21 per ton.

A complete fertilizer requires nitrogen, phosphoric acid and potash. Your muck would furnish the nitrogen, but would require the addition of the other two substances. The phosphoric acid can be added in the form of dissolved bone black or of dissolved South Carolina rock, and the potash in the form of unleached ashes or of German potash salts.

Potash Salts.

The German potash salts come to this country in several forms, the principal of which are sulphate of potash, muriate of potash, and kainite. The sulphate is the most expensive, and no sample of this was received at the Station during the year.

Two samples of kainite were sent by E. L. Bass of West Randolph, obtained from the Bowker Fertilizer Co.

No. 1 contained 9.77 per cent of actual potash.

No. 2 contained 9.89 per cent of actual potash.

The selling price was $18.00 per ton, which would make the potash in No. 1 cost 9 2-10 cents a pound, and in No. 2 9 1-10 cents.

A sample of muriate of potash sent by Mr. Bass obtained from the same firm contained 51.34 per cent of potash and sold for $47.00 a ton, the potash thus costing 4 1-2 cents a pound.

A second sample of muriate of potash sent by Geo. Campbell's Sons, Westminster, West, Vt., was found to contain 48.50 per cent of actual potash. No cost price was given, but at the same price as the preceding $47.00 a ton, it would make the potash cost 4⅞ cents a pound.

It will be seen then that at this distance from the port of entry, the muriate is much the cheaper source of potash.

Annatto Seed.

Phosphoric Acid	Trace.
Nitrogen	1.98
Potash	4.26
Valuation per ton	$10.55

This was a sample of the kiln-dried refuse from the butter color manufactory of Wells & Richardson Co., Burlington, Vt.

Refuse Bone.

Sample sent by B. H. Porter, Burlington, taken from a quantity of refuse from the Queen City Soapworks, Burlington. The bone had been boiled and steamed until it was quite thoroughly disintegrated and in condition to decay rapidly in the soil.

Phosphoric Acid	23.37
Nitrogen	.80
Valuation per ton	$30.76

Tankage.

Also sent by Mr. Porter. It was the kitchen refuse from a large summer hotel. The grease had been extracted for the manufacture of soap. Obtained at the Queen City Soapworks.

Phosphoric Acid	2.23
Nitrogen	2.55
Valuation per ton	$11.30

Compost.

Sent by Mr. Porter. Sample taken from a pile of material where a warehouse containing a large amount of wool had been burned.

Water	42.00
Stone, etc.	18.00
Phosphoric Acid	1.16
Nitrogen	.70
Potash	.29
Valuation per ton	$3.88

Hall's Lime Fertilizer.

Sample sent by J. C. Giddings, Rutland. Found to be ground limestone. Much of this has been used the past year in the southwestern part of the State. But it still remains questionable whether the soils of Vermont have not already a sufficiency of lime.

FIELD EXPERIMENTS WITH FERTILIZERS.

—:o:—

At the present market prices, phosphoric acid that has been treated with acid to make it readily soluble costs more than twice as much as the same phosphoric acid in its native undissolved form. It becomes then a question of great practical importance to the farmer, whether there are not some crops, or some kinds of soil, on which these cheaper undissolved phosphates can be used to advantage in place of the dissolved phosphates (superphosphates), which are those now principally used.

Phosphates are used in this State for two general purposes: first, the furnishing of plant food so as to bring the crop to full size and weight and secondly to furnish that food in a form so soluble and easily available that the growth of the crop will be quickened, its younger growth more vigorous, and the effects of this be seen in a larger and earlier ripened crop. For the last named purpose the undissolved phosphates would not answer, and it is this use of the phosphoric acid that is largely in the mind of our farmers when they buy superphosphates for use on corn, potatoes and vegetables. On the contrary when a farmer puts on twenty to twenty-five loads of stable manure per acre to the field that he is stocking down to clover and timothy, he does not expect nor wish that all this large amount of plant food shall be dissolved and become available the first year. It is such cases as this which present the most promising field for the economical use of undissolved phosphates, and for this reason the grass crop was the one chosen by the Station for its experiments with these phosphates.

Two kinds of phosphates were tried, the fine ground South Carolina rock (known in the trade as "floats," because it is ground so fine that it floats out of the grinder in the current of air that is made to pass constantly through the machine), and

fine ground bone black, a refuse product from the sugar refineries. These two sources furnish most of the phosphoric acid in the mixed fertilizers sold in this State.

The fertilizers were put up at the Station in sets of five bags each; each bag to be spread broadcast on one-tenth of an acre. The first bag contained South Carolina rock, at the rate of 40 pounds of phosphoric acid per acre; the last, bone black sufficient to yield the same quantity of phosphoric acid; the second and fourth were for comparison, and contained no phosphate—nothing but muriate of potash; the middle bag was the same as the sum of the first and last plus plaster at the rate of 200 pounds to the acre. The same amount of potash was supplied in each, namely at the rate of 15 pounds actual potash per acre. The nitrogen and more potash was supplied by a top dressing of stable manure, which is rich in nitrogen and contains considerable potash, but is relatively poor in phosphoric acid. On the next page will be found copies of the instructions sent out with the fertilizers and of the blank used for reporting results. These experiments were tried on fifty-four farms scattered quite evenly over the whole State. The first year's results have been received, but a full discussion of them will be reserved until the completion of the experiment this fall.

These same fertilizers were tried on plots on the grounds of the University in competition with dissolved South Carolina rock, and on an adjoining field in comparison with a sample of the Cumberland Seeding Down Fertilizer, an undissolved phosphate sent to the Station especially for this trial by the Cumberland Bone Co., Portland, Me.

Take this Paper in to the field with you.

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DIRECTIONS

FOR CONDUCTING THE EXPERIMENTS WITH FERTILIZERS.

These experiments are to be tried on permanent grass land, that is, on land which is to be used to raise hay for at least the next two years. Mark out five plots, each sixteen rods long and one rod wide, (one tenth of an acre,) leave a space of three feet between the plots; the plots should run up and down the slope, if any, and be marked by a stake at the middle of the length, thus:

R.	South Carolina Rock.
O.	No Phosphate.
R B.	South Carolina Rock, Bone Black and Plaster.
O O.	No Phosphate.
B.	Bone Black.

Scatter well rotted stable manure evenly over the land at the rate of five two-horse loads to the acre. Begin at one end, spread on broadcast, one bag on each plot in the following order: R. O. RB. OO. B. You will then have put on the first one, South Carolina rock; on the third, South Carolina rock, bone black and plaster; on the fifth, bone black, and the same amount of potash on each.

Mark out the plots as soon as the frost is out of the ground, spreading the manure and the fertilizers as soon afterwards as convenient. Note the growth at different times in Summer; cut for hay at the same time you do the rest of the field. Keep the hay from each half of each plot by itself and weigh when ready for the barn. Note carefully the weights in the proper columns of the blanks for reports. Preserve one copy for your own use and send one to the Station as soon as completed.

W. W. COOKE.
Director.

STATE AGRICULTURAL EXPERIMENT STATION,
Burlington, Vt., April 10, 1887.

1887.

RECORDS OF FIELD EXPERIMENTS WITH FERTILIZERS.

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Name of Experimenter.....
P. O. Address.....
Lay of the land.....
Kind of soil.....
Dry or wet.....
Depth of surface soil.....
Character of sub-soil.....
Treatment in previous years as regards fertilizers.....
.....
How long has it been in grass.....
Kind of grass.....
Date of applying fertilizers.....
Character of weather during growing season (warm or cold, wet or dry, etc.).....
April..... May.....
June..... July.....
August..... September.....
Date of first cutting.....
State of growth at first cutting.....
Condition when weighed.....
Date of second cutting if cut twice.....
Stage of growth at second cutting.....
Condition when weighed.....
Character and approximate quantity of aftermath.....
.....

Number of plot.	KIND OF FERTILIZER.	YIELD IN POUNDS PER PLOT.				APPEARANCE AND QUALITY OF HAY.
		First Cutting.		Sec'nd Cut'ng.		
		Upper half.	Lower half	Upper half.	Lower half.	
..	.....	.....	.....	.....	.....	.....
R	South Carolina Rock.					
....	.....	.....	.....	.....	.....	.....
O	No Phosphate.					
....	.....	.....	.....	.....	.....	.....
R B	S.C. Rock, B'e Bl'k and Plas.					
....	.....	.....	.....	.....	.....	.....
OO	No Phosphate.					
....	.....	.....	.....	.....	.....	.....
B	Bone Black.					

ANALYSIS OF MATERIALS USED BY THE STATION IN ITS EXPERIMENTS WITH FERTILIZERS.

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South Carolina Rock (Floats).

Bought for Station experiments of Bowker Fertilizer Co., Boston, Mass.

Total Phosphoric Acid	26.95

About four-fifths passed a sieve of 100 meshes to the inch.

Bone Black.

Bought for Station experiments of Wells & Richardson Co., Burlington, Vt. This was the refuse bone black from their milk-sugar refinery.

Total Phosphoric Acid	19.97
Nitrogen	.58

One-half went through a 1-50 inch mesh, and the rest through a 1-24 inch mesh.

Cumberland Seeding Down Fertilizer.

Sent to Station for experiments by Cumberland Bone Co., Portland, Me.

Soluble Phosphoric Acid	2.20
Reverted Phosphoric Acid	3.53
Insoluble Phosphoric Acid	17.91
Available Phosphoric Acid	5.73
Total Phosphoric Acid	23.64
Nitrogen	1.55
Potash	.85

Dissolved South Carolina Rock.

This material is known in the trade as "Plain Superphosphate." Bought for Station experiments of Bowker Fertilizer Co., Boston, Mass.

Soluble Phosphoric Acid	10.91
Reverted Phosphoric Acid	3.41
Insoluble Phosphoric Acid	1.55
Available Phosphoric Acid	14.32
Total Phosphoric Acid	15.87

Dried Blood.

Bought for Station experiments of Bowker Fertilizer Co., Boston, Mass.

Nitrogen	9.14

FIELD EXPERIMENTS WITH NEW FODDER CROPS.

——:o:——

During the past summer the Station has undertaken to test some new fodders not often grown in this State, to see whether they are adapted to our soil and climate. To make the test as thorough as possible packages of the seed were sent to more than forty different farmers all over the State.

Alfalfa.

This plant, a kind of clover, is grown quite extensively in Europe, where it is known as lucern. For many years it has been successfully and profitably raised in California, and has lately been introduced on the western prairies and throughout the South. The question in Vermont is, whether it will stand our severe climate without winter-killing.

The following instructions were sent with the packages of seed:

The seed sent is sufficient for one-fifth of an acre. Select land that is naturally well drained and from which the snow does not blow off in winter. Plow and harrow well. Sow the seed broadcast, early in May. If growth is light, do not cut the first year; if heavy, cut just as it begins to bloom. Do not cut nor feed the aftermath the first year.

At the end of the season, report to the Station: date of sowing, character of land, date of cutting, appearance and approximate quantity of fodder, how it was relished by stock, condition of the crop just before the first frost.

Many reports have been received and the general condition of the plots, when cold weather set in, was fairly good, but whether or not the experiment will prove successful cannot be told until warm weather reveals how the roots have withstood the winter.

Cow Pea.

Called a pea, but more resembling a bean, the cow pea has a high reputation in the South as a fodder plant and for plowing under as green manure. The special reason for endeavoring to introduce this plant in Vermont was the fact that it is a more concentrated, richer feed than any crop now raised in the State and would make an excellent article to be fed with corn fodder or ensilage to make a complete and correctly balanced ration.

The seed was obtained from J. J. Wolfenden, New Berne, N. C., and cost a dollar a bushel plus the freight. The following directions were sent out with the packages of seed:

The seed sent is sufficient for one-fifth of an acre. Good land can be used for the production of a heavy growth of fodder, or poor weedy land for the double purpose of raising fodder and killing the weeds. Sow in drills three and a half feet apart and about ten seed to the foot. Plant the same time as you would beans; cultivate the same as beans, until the growth of runners begins to fill the space between the rows. If desired for green fodder, begin to cut about the middle of August; if for hay, cut late in the fall, just before the time of heavy frosts.

At the end of the season, report to the Station: date of sowing, character of land, date when the runners commenced to grow, appearance and stage of growth August 1st, date of cutting, character and approximate quantity of hay or green fodder produced. Did it produce any matured seeds? How was it relished by stock? What was its apparent effect on the flow and quality of the milk? Judging from the results of this season's growth, would it pay you to raise it on a larger scale as a fodder plant?

In accordance with these instructions, reports were sent by most of those who received the seed. A brief abstract of these reports is given on the following pages, from which it can be judged whether the plant is likely to be a success in this State.

STATION EXPERIMENTS WITH COW PEA.

NAME.	TOWN.	Character of land.
E. L. Bass	West Randolph.	Good clay loam, heavily manured.
Geo. Beecher	Essex.	Good soil.
O. W. Bishop	Andover.	Good corn land.
Henry Blake	East Hardwick.	
G. B. Bullard	St. Johnsbury.	Damp clay soil, very muddy.
S. B. Chapman	Windham.	A side hill.
G. A. Clough	Thetford Centre.	Sandy loam soil.
Dr. H. A. Cutting	Lunenburgh.	Upland loam, 1800 feet above sea level. Soil in good condition.
De Witt Davis	Chester Depot.	A loam soil.
A. E Higley	Benson.	Light gravelly soil.
E. H. Hoffman	Lyndon.	Light soil, gravel bottom.
M. H. Miller	Pomfret.	Sandy loam.
G. N. Ober	Athens.	Sandy loam, well manured.
Geo. I. Perkins	South Walden.	An old garden, very rich and weedy.
D. R. Pierce	Waterville.	A side hill, wet and stony.
S. W. Pitkin	Marshfield.	Warm slate and granite soil.
S. N. Shattuck	Eden.	Gravelly loam greensward.
T. B. Smith	Stowe.	Good strong soil, not wet; no clay or sand.
La Roy Southworth	Middletown Spa.	Loamy but too low and wet.
A. M. Stevens	East Hardwick.	Old ground, well manured.
D. W. Stevens	Greensboro Bend.	Dry.
Geo. F. Tanner	Springfield.	Rich.
H. R Tarbell	Chester.	Rich ground.
S. H. Tilley	Williston.	
F. S. Tomlinson.	Jericho Centre.	Well drained, sandy loam.
H. W. Vail.	Pomfret.	Rich, well manured.

STATION EXPERIMENTS WITH COW PEA.

Date of sowing.	Date when the run'ers com'enced to grow.	Appearance and stage of growth August 1.	Date of cutting.
May 30.	.....	.....	.....
.....	.....	.....	.....
May 24.	August 1.	About 2 feet high.	August 16.
June 1.	.....	.....	.....
May 26 or 27.	.....	.....	.....
Middle of June.	.....	.....	.....
June 6.	.....	Just begun to branch out a little.	Cut a little green, the rest Aug. 28.
May 21.	July 6.	Fair but uneven growth, and spots on leaves.	.....
May 28 and 30.	Last of July.	Good thrifty condition.	Commenced about the middle of August.
In June.	.....	.....	In August.
June 10.	Middle of July.	About 2 feet high, runners well out.	Last of Aug. and first of Sept.
May 27.	August 10.	10 to 12 inches high.	September 1.
June 15.	Middle of July.	Growing finely.	Aug. 25.
June 2.	July 20.	.....	.....
June 2.	.....	Not fully grown. No blossoms.	.....
.....	.....	.....	.....
May 25.	July 1.		
.....	.....	Looking well.	.....
June 9.	No run'rs.		.....
.....	.....	Light growth.	August 15.
May 25.	July 1.	Nearly covered the ground.	September 12.
May 23.	.....	.....	.....
.....	.....	.....	.....
May 18.	No run'rs.	18 inches high.	September 1.
Early in June.	August 1.	.....	Did not cut it.
.....	.....	Grew luxuriantly.	August 20.
May 28. June 8.	August 5.	.....	.....
June 7.	Last of July.	.....	First of Sept.
.....	.....	.....	.....

STATION EXPERIMENTS WITH COW PEA.

NAME.	Character and approximate quantity of hay or green fodder.	Did it produce any matured seeds?	How was it relished by stock?
E. L. Bass	....	Few p'ds, no large peas.	Cows ate it greedily.
Geo. Beecher	Very heavy growth. Covered the ground.	....	Cows ate it well.
O. W. Bishop	....	No.	Cows and calves liked it, but horses did not.
Henry Blake	½ as much as same number rows of corn.	No blos'ms.	5 cows out of 17 would not eat it.
G. B. Bullard	....	No.	Cows did not relish it either green or dry.
S. B. Chapman	....	....	....
G. A. Clough	2½ feet high.	....	Cows did not like it.
Dr. H. A. Cutting	One ton of hay to the acre.	No.	Cattle would not eat it. Sheep relished it.
De Witt Davis	At the rate of 10 2-5 tons to the acre.	No.	Stock relished it, only one cow refused to eat it.
A. E. Higley	Yield was better than large yield of clover.	Some seeds matured.	Cattle ate it readily.
E. H. Hoffman	About 3 ton of green fodder per acre.	Didn't blossom.	Very much.
M. H. Miller	About 2 feet high, with run'rs 1 ft. long.	No seeds or pods.	Not so well as corn.
G. N. Ober	12 ft. sq. weighed 250 lbs. green, 70 lbs. dry.	No blossoms.	Did not like it at first, but learned to eat it.
Geo. I. Perkins	More weeds than peas.	....	....
D. R. Pierce	1200 or 1500 lbs., crop badly washed away.	No.	As well as corn or any green fodder.
S. W. Pitkin	1 sq. rod weighed 142 lbs.	....	Eaten readily by cows.
S. N. Shattuck	½ ton.	Did not blossom.	....
T. B. Smith	About 4 tons per acre.	Few blows or pods.	....
La Roy Southworth	....	....	....
A. M. Stevens	....	....	....
D. W. Stevens	....	No.	Very much.
Geo. F. Tanner	Corn on same l'nd produced 4 times more.	No.	Was relished by cows.
H. R. Tarbell	....	....	Cattle ate it like sweet corn.
S. H. Tilley	....	....	....
F. S. Tomlinson	A fair growth.	No.	Very much.
H. W. Vail	A fair growth.	....	Cows ate it readily.

STATION EXPERIMENTS WITH COW PEA.

Remarks.	Would it pay to raise it on a larger scale?
Effect on milk no better than Sanford corn. Can get more corn to the acre, can handle it faster and it is better feed.	Prefer corn.
	.....
Quantity of milk less than that produced by feeding sweet corn.	Corn is more profitable.
I condemn them. It takes too much cutting to make cows eat them.	Much inferior to corn.
.....	Impression unfavorable.
Rust or blight struck them and they ceased to grow, wilted and withered.	.....
Put part in silo and dried the rest for hay.	Want nothing more to do with it.
.....	No.
It increased the quantity and quality of the milk. In an ordinary season it would have made a bigger crop.	Yes.
I think it is a good feed.	.....
Cured easily. A change from fodder corn produced an increase of 6 qts. of milk from 12 cows and larger propor'ate increase in butter, prefer it to corn for fall feed.	On better land more heavily manured, it would be profitable.
.....	Would not pay me. Prefer corn.
Fed 2 cows alternate weeks on peas and corn. Flow of milk greater when fed on corn. As to quality, little difference.	.....
On account of weeds could not estimate their value.	Will not pay so well as corn for fodder.
It has good milk producing qualities; equal to corn in this respect; milk very sweet.	Depends on cost and trouble getting seed.
Produced a good flow of milk and a good quality of butter.	Sown broadcast it might pay.
Made no difference in quality or flow of milk.	Would not pay for me to raise it.
Peas planted too late. Cows gave ¼ more after a few days on peas. On corn fodder 11 cows gave 8 qts. more.	Prefer corn fodder.
Ground was not well chosen.	It might in a suitable field.
Total failure, no more than 25 came up.	.....
Like corn better; it may be well on moist land. It increased the flow of milk.	.....
Could see no difference in quantity or quality of milk.	It would not pay me.
First frost proved it to be tender.	Corn is better.
.....	.....
Did not increase the flow of milk, but added very much to the quality.	Yes.
Stored it, thinly spread over the mows.	.....

The experiments with the cow pea may be summarized as follows: Seed was sent to thirty-seven farmers. Reports have been received from thirty of these, which show that the crop made a medium to good growth in twelve cases, and a failure in twelve cases, the rest being indeterminate. Five only out of the whole number think there is a chance that it would pay them to raise it as a regular farm crop, while eleven farmers very strongly pronounce it inferior to corn as a fodder plant.

This would seem to decide quite thoroughly, that the cow pea is not a plant that will prove a benefit to the generality of farmers so far north as Vermont.

COMPOSITION OF FERTILIZING MATERIALS.

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The following table gives the *average* composition of such fertilizing materials as are offered for sale in New England markets. The figures are compiled from the published reports of the several New England Experiment Stations, with the addition of a few analyses from other sources.

SUBSTANCE.	Nitrogen.	Total Phosphoric Acid.	Available Phosphoric Acid.	Insoluble Phosphoric Acid.	Potash.
Materials Containing Nitrogen.					
Nitrate of Soda	15.93	.....	.....	.....	.....
Nitre Salt Cake	2.29	.....	.....	.....	0.87
Saltpetre Waste from Gunpowder Works	2.43	.....	.....	.....	18.00
Sulphate of Ammonia	20.40	.....	.....	.....	.....
Dried Blood	11.01	1.91	.....	.....	.....
Hoof Meal	15.10	0.10	.....	.....	.....
Horn and Hoof Waste	14.47	2.30	.....	.....	.....
Wool Waste	6.56	.....	.....	.....	.....
Materials Containing Phosphoric Acid.					
Apatite	.....	38.00	.....	.....	.....
Bolivian Guano	.....	17.20	.....	.....	.....
Bone Black (refuse)	.....	28.84	.....	.....	.....
Bone Black (dissolved)	.....	17.00	16.70	0.30	.....
Carib. Guano	.....	18.9[illegible]	.....	.....	.....
Cuba Guano	1.67	17.94	.....	.....	0.67
Connetable Island Floats No. 1	.....	41.40	.....	.....	.....
do do do No. 2	.....	26.40	.....	.....	.....
Grand Cayman Island Phosphate	.....	27.70	.....	.....	.....
Navassa Guano	.....	29.63	.....	.....	.....
Orchillo Guano	.....	26.77	.....	.....	.....
Phosphoral	.....	49.40	.....	.....	.....
South Carolina Rock (ground)	....	27.46	0.58	26.88	.....
do do do (floats)	.....	27.20	.....	.....	.....
do do do (dissolved)	.....	15.20	11.60	3.60	.....
Thomas Slag (English)	.....	19.40	6.09	13.31	.....
do do (German)	.....	30.51	.....	.....	.....

SUBSTANCE.	Nitrogen.	Total Phosphoric Acid.	Available Phosphoric Acid.	Insoluble Phosphoric Acid.	Potash.
Materials Containing Potash.					
Muriate of Potash	.....	.....	.....	.....	51.88
Sulphate of Potash	.....	.....	.....	.....	35.86
Sulphate of Potash and Magnesia	.....	.....	.....	.....	24.30
Carnallite	.....	.....	.....	.....	13.68
Kainit	.....	.....	.....	.....	13.32
Krugit	.....	.....	.....	.....	8.41
Saltpetre Waste from Gunpowder Works	2.43	.....	.....	.....	18.00
Materials Containing Nitrogen and Phosphoric Acid.					
Bat Guano	6.47	3.76	.....	.....	.....
Bones (ground)	3.91	22.50	6.89	15.61	.....
do (dried and extracted with benzine)	6.20	20.10	.....	.....	.....
do (from glue factory)	1.70	29.90	.....	.....	.....
Castor Pomace	5.38	1.93	.....	.....	1.06
Cotton Seed Meal	6.10	1.45	.....	.....	0.89
do do do (damaged)	3.73	1.26	.....	.....	1.21
Dry Ground Fish	8.40	7.30	.....	.....	.....
Peruvian Guano	7.85	18.94	8.36	10.58	2.61
Tankage	7.59	14.25	4.08	10.17	.....
Tobacco Stalks	0.40	0.20	.....	.....	1.50
Tobacco Stems	2.20	0.60	.....	.....	6.47
Ammoniated Superphosphate. Average of Vermont Samples, 1887	2.94	11.13	9.19	1.94	2.77
Ashes, Muck, Peat, etc.					
Chestnut R. R. Ties Ashes	.....	1.54	.....	.....	0.19
Cotton Seed Hull Ashes	.....	8.41	.....	.....	22.08
Hard Pine Wood Ashes	.....	2.24	.....	.....	10.16
Lime Kiln Ashes	.....	1.18	.....	.....	0.86
Mill Ashes	.....	0.46	.....	.....	1.60
Spent Tan Bark Ashes	.....	1.36	.....	.....	2.47
Wood Ashes (Canada)	.....	1.81	.....	.....	5.50
do do (unleached)	.....	1.80	.....	.....	6.20
do do (leached)	.....	1.40	.....	.....	1.10
Muck	0.91	.....	.....	.....	.....
Peat	0.71	.....	.....	.....	.....
Dead Chestnut Leaves	0.70	0.20	.....	.....	0.40
Dead Oak Leaves	0.50	0.30	.....	.....	0.20
Farm Manures.					
Cow Manure	0.50	0.30	.....	.....	0.50
Horse Manure	0.60	0.50	.....	.....	0.50
Mixed Stable Manure	0.60	0.50	.....	.....	0.60
Hen Dung	0.90	0.60	.....	.....	0.40
Night Soil	0.80	1.40	.....	.....	0.30

TEST OF THE AVAILABILITY OF BONE MEAL, WHEN FED TO MILCH COWS.

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The following tests, planned by the Station, were carried out on his farm by Mr. B. H. Porter, Burlington, Vt:

The question to be tested was this: When bone meal is fed to cows, do the acids of digestion have a dissolving action on the phosphate similar to that of sulphuric acid, rendering the bone after it has passed through the animal, immediately available for plant food. In other words, can we use the machinery of the cow to dissolve bones in place of using sulphuric acid. Bone meal has considerable feeding value, and is used quite freely in some parts of the State as a cattle food.

The reasoning of the succeeding experiment was this: The solid portion of the excrement represents the part undigested, hence undissolved. All of the food not found in the solid excrement must have been digested and dissolved. Hence if, on adding largely of bone phosphate to the food, we fine little or no increase of phosphate in the solid excrement, we can reason that all the added phosphate was dissolved and carried out of the body in a soluble and hence immediately available form.

A three-year-old grade Jersey cow was selected for the trial. The feed given at first was eight quarts per day of a grain mixture composed of six parts corn and cob meal to five parts of gluten meal and five parts of mill sweepings. After this had been fed for some time, the solid manure was carefully saved for five days. It was weighed, mixed thoroughly and a sample taken for analysis. To this hay and grain feed was then added a half pound of bone meal twice a day. After five days feeding the solid manure was again saved for six days, weighed, mixed and sampled as before.

Composition of the Solid Manure.	With Bone Meal. per cent.	Without Bone Meal. per cent.
Moisture	83.650	80.000
Soluble Phosphoric Acid	none.	none.
Reverted Phosphoric Acid	0.132	0.075
Insoluble Phosphoric Acid	0.058	0.075
Available Phosphoric Acid	0.132	0.075
Total Phosphoric Acid	0.190	0.150
Potash Soluble in Water	0.309	0.366
Potash Insoluble in Water	0.051	0.074
Total Potash	0.360	0.440
Nitrogen Soluble in Pepsin Solution	0 088	0.109
Total Nitrogen	0.240	0.310
Valuation per ton	$1.35	$1.61

Amount Per Day.	With Bone Meal. lbs.	Without Bone Meal. lbs.
Solid Manure, average	40,000	42,000
Soluble Phosphoric Acid	none.	none.
Reverted Phosphoric Acid	0.055	0.030
Insoluble Phosphoric Acid	0.024	0.030
Available Phosphoric Acid	0.055	0.030
Total Phosphoric Acid	0.079	0.060
Total Potash	0.151	0.176
Total Nitrogen	0.101	0.124

The period of feeding at the barn in Vermont is about two hundred days. At a pound a day ten cows would just eat up a ton of bone meal during the winter. These ten cows would then have produced in their manure as compared with ten similar cows not fed bone meal :—

	lbs.	lbs.
Reverted Phosphoric Acid	110.	60.
Insoluble Phosphoric Acid	48.	60.
Available Phosphoric Acid	110.	60.
Total Phosphoric Acid	158.	120.
Total Potash	302.	352.
Total Nitrogen	202.	248.

But this ton of bone meal would have contained 420 lbs. of phosphoric acid. The cows that ate this only produced 158—120=38 lbs. more of phosphoric acid in the solid excrement than the others. Then the rest of the 420 lbs., or 382 lbs. of phosphoric acid would have been dissolved and made immediately available. This part would be found in the liquid portion of the manure. It ought to be needless to add that no one could profitably feed bone meal unless he was prepared to save both the solid and liquid portions of the manure.

Bone meal has a real feeding value. The sample used in this test was that made by A. R. Robinson of Winooski, and its analysis is given on page 60. The amount of fat present was determined to be 10.22 per cent and of protein, 25.63 per cent. It may be correctly considered that all of both the fat and protein is digestible. If we count its value on the same basis as that given before, i. e., 4 1-3 cents per pound, we have the following as the feeding value per ton of this bone meal:

512.6 lbs. digestible protein at 4 1-3 cents	$22.21
204.4 lbs. digestible fat at 4 1-3 cents	8.86
Feeding value per ton	$31.07

Its fertilizing value before feeding is given as $35.64. Its value for a fertilizer after feeding would be found as follows:

382 lbs. soluble phosphoric acid at 8 cents	$30.56
38 lbs. insoluble phosphoric acid at 3 cents	1.14
65.6 lbs. nitrogen at 17 cents	11.15
Fertilizing value per ton	$42.85
Total feeding and fertilizing value	73.92

COMPOSITION OF FODDERS.

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On the following pages will be found a table giving the chemical composition of various fodders. These figures are compiled from several sources and are all averages of many analyses. In the first column is given the number of analyses of which these are the average, and the greater that number the more likely that the figures correctly represent the average character of the fodder. Chemists are in the habit of using certain terms in giving their analyses of cattle fodders, and it will be necessary for us to explain the meaning of these terms in order that the analyses given in this volume and those found in the bulletins and reports of other stations may be intelligible to the average farmer. By *moisture* is meant the amount of water in the fodder which is driven off when the substance is exposed for quite a long time to a temperature just equal to that of boiling water. If now we take this dry fodder and submit it to the action of boiling ether for several hours, we will extract from it what is called by some chemists *fat* and by others *ether extract*. If we were to take corn meal and submit it to this action of boiling ether, what was dissolved from it would be almost pure fat. But if we were to take the corn stover or hay or clover or any coarse fodder and boil it with ether, we would get out not only what fat there was there but also nearly all of the coloring matter; the ether extract would be a bright green. Now this coloring matter has but very little feeding value, so that the ether extract from coarse fodder has not nearly so high a feeding value as the matter extracted by ether from corn meal and from other grains. If after treating the fodder with ether we should take what is left and boil it alternately with acid and with alkali, such as sulphuric acid and potash lye for instance, we would dissolve out from this fodder everything but the coarse, hard, woody framework of the original plant. This framework is what the chemist calls the *crude fibre*, and is the least valuable

part of the fodder. It must not be supposed that this crude fibre has no feeding value, for it has been conclusively proved that cattle can digest large quantities of even this hard material. But its value is secondary to that of the rest of the fodder. In all fodders we find a class of substances which are called by the chemists *albuminoids* or *protein*, so called because they resemble in chemical composition the albumen or white of the egg. They are distinguished from all the other materials found in fodder by containing nitrogen. Throughout the animal or vegetable kingdom we find a large number of substances very different in appearance and physical characteristics, but nevertheless agreeing very closely in their chemical composition, and all known under the general name of albuminoids. Among the most common of these may be mentioned the albumen or white of the egg, the casein of milk from which the cheese is made, the fibrin or lean part of meat, the gluten of wheat and other cereals, and the protein or albuminoids of fodder. In the chemical analysis of fodder the amount of albuminoids present is always estimated by determining the amount of nitrogen and multiplying this by $6\frac{1}{4}$, since it has been found that albuminoids weigh in general $6\frac{1}{4}$ times as much as the amount of nitrogen contained in them, that is, they contain on the average 16 per cent of nitrogen. If now we add the per cents we have obtained for *moisture*, *fat*, *crude fibre*, *albuminoids*, and subtract this sum from 100, we get the per cent of the remaining substances in the fodder, which are classed by the chemist under the heading of *non-nitrogenous extract matter*. They consist very largely of starch, sugar, gum, etc., and could be estimated directly by boiling the fodder, driving off the water, and weighing the amount which has been dissolved out of the fodder by the water. But as a fact chemists always calculate the amount of this non-nitrogenous matter by difference.

What part in the economy of the animal is taken by each of these ingredients of fodder? We may say in the first place that the *moisture* is without feeding value. The water that is contained in fodder is of no more value than the water which we regularly give to our animals to drink. As would naturally be supposed, the *fat* of the fodder may be taken into the system and help to produce the fat that is given

out in the milk or is laid up in the body during fattening. But it seems to be quite well proven that it has to undergo some change or other in passing through the system of the animal before it can be finally laid up in either form. This idea has been denied by many writers. But the experiments lately tried by Dr. Babcock at the New York Experiment Station seem to prove it most conclusively. He took a cow and tested the physical characteristics of the fat of her milk and then fed her largely with cottonseed meal, the oil of which has very great differences from the oil of butter, and the slightest trace of which if mixed mechanically in the butter could have been detected; and yet notwithstanding the cow was fed very heavily and for quite a long period there was practically no difference noticed in the character of the oil of the milk, showing that in passing through the organs of the animal the cottonseed oil had in some way been acted upon, and those physical properties which mark it so strongly had been taken away and the oil had been changed into regular butter fat. Nevertheless it does seem probable that the small amounts of sulphurized oils which exist in onions, turnips, etc., and give them their characteristic strong odors may be sometimes carried through and deposited unchanged, or but slightly changed, in the milk, imparting to it the odor of the original vegetable. Yet the fact that turnips can be fed in small quantities to cows directly after milking seems to show that even these oils may be acted upon and broken up by the digestive apparatus of the animal.

The *crude fibre* of the fodder has for its office in the system the production of heat, and there seems to be no reason for thinking that it is ever used by the animal for any other purpose. The *nitrogen free extract* is used principally for the production of heat, but it seems pretty conclusively proved that it *may* under some circumstances, and very likely does under all, contribute also to the formation of fat. The remaining part of the food, the *albuminoids*, is by far the most important. This is the only part of the food which can be used for the production of energy, muscular exertion. But it may also serve for all the other functions of the body. It may produce energy, it may qe stored up in the body as the principal component of the flesh,

it may be stored up in the body as fat, it is the only source from which the casein or cheesy part of the milk can be obtained, it may and probably does constitute one of the principal sources from which the fat of the milk is obtained, or it may be used for the production of heat.

The figures in the table can be taken to represent percentages, or they can be read as pounds in a hundred. Thus the first one given can be read alfalfa contains 5.91 per cent. of protein, or 100 lbs. of alfalfa contain 5.91 lbs. of protein. To find the number of pounds of each ingredient in a ton, multiply the figures given in the table by 20.

COMPOSITION OF FODDERS—TABLE I.

SUBSTANCE.	Number of Analyses.	Water.	Protein.	Fat.	Nitrogen-free Extract.	Crude Fibre	Ash.
Green Fodder.							
Alfalfa	4	67.46	5.91	1.15	12.02	10.51	2.95
Amber Cane	3	82.44	1.17	0.39	9.32	5.94	0.74
Beet Leaves	1	88.84	2.74	0.60	2.49	2.50	2.83
Cabbage Leaves	1	89.86	1.83	0.47	3.51	2.98	1.35
Carrot Leaves	1	83.30	4.26	0.86	5.99	2.25	3.34
Cow Pea Vines	3	80.31	2.70	0.47	7.41	7.22	1.89
Fodder Corn	60	80.61	1.65	0.46	10.74	5.43	1.11
Orchard Grass	3	71.48	2.65	1.22	12 28	10.23	2.14
Prickly Comfrey	3	84.36	2.94	0.51	7.13	2.61	2.45
Red Clover	22	68.57	4.49	1.27	13.92	9.70	2.05
Rye Fodder	6	75.28	2.61	0.56	6.94	12.73	1.88
Sorghum	7	78.35	1.11	0.36	13.07	6.24	0.87
Timothy	24	56.16	3.24	1.37	23.15	13.98	2.10
White Lupine	1	85.35	2.74	0.35	6.25	4.57	0.74
Ensilage.							
Apple Pomace	1	85.33	1.21	1.08	8.51	3.25	0.62
Cabbage	1	87.61	1.19	0.93	4.52	1.59	4.16
Clover	3	76.27	3.34	1.02	10.21	6.66	2.50
Corn Stalks	2	59.29	3.62	2.46	24.80	8.11	1.72
Fodder Corn	57	80.15	1.54	0.72	10.59	5.68	1.32
Cow Pea Vines	1	81.64	2.40	0.80	7.60	5.57	1.99
Hungarian	1	60.51	3.30	2.33	17.51	13.60	2.75
Rowen	1	81.56	2.28	1.29	8.10	5.15	1.62
Rye Fodder	1	80.75	2.42	0.27	9.18	5.76	1.62
Sorghum	5	75.83	0.75	0.28	15.82	6.28	1.04
Hay and Coarse Dry Fodder.							
Alfalfa	2	8.37	11.03	1.64	46.24	25.84	6.88
Alsike Clover	3	9.14	13.13	2.91	40.06	25.27	9.49
Buckwheat Straw	2	10.45	3.85	1.56	33.21	45.88	5.05
Clover	48	13.70	12.26	2.98	38.68	26.50	5.88
Clover Rowen dry	2	14.33	11.08	3.20	36.36	28.80	6.23
Corn Stover	5	18.55	6.11	1.65	43.51	25.04	5 14
Cow Pea	2	9.48	15.37	3.48	41.83	20.80	9.04
Cow Pea Vines, dry	6	11.05	15.68	2.87	42.17	19.82	8.41
Fodder Corn	6	32.05	4.29	1.24	35.96	22.14	4.32
Hay of Timothy and Red-top	10	14.40	6.51	2.45	39.34	32.24	5.06
Hay of Barley (seed in milk)	1	10.25	9.21	2.47	47.49	26.14	4.44
Hay with much Clover	8	13.94	10.41	2.59	41.59	25.97	5.50

COMPOSITION OF FODDERS.

Substance.	Number of Analyses.	Water.	Protein.	Fat.	Nitrogen-free Extract.	Crude Fibre.	Ash.
Hay of Oats (in blossom)..	1	6.43	6.16	2.73	46.81	31.87	6.00
Hay of Oats (seed in milk).	2	9.15	8.85	2.74	44.71	28.07	6.48
Hay of Ripe Oats.....	1	8.70	5.52	2.38	44.67	33.15	5.58
Hay of Winter Rye.....	1	8.55	9.75	2.35	43.35	30.15	5.85
High Meadow Hay.....	2	10.98	7.57	2.25	47.19	25.78	6.23
Horse Bean Straw.....	1	9.15	8.80	1.37	34.32	37.65	8.71
Hungarian Grass..... ..	6	6.45	6.79	2.55	49.69	29.09	5.43
Low Meadow Hay.....	10	10.50	7.70	2.20	43.60	30.20	5.80
Oat Straw.....	6	10.79	3.35	2.26	36.48	42.24	4.88
Orchard Grass Hay.....	5	9.34	8.19	2.57	40.38	33.11	6.32
Pearl Millet.....	3	7.37	7.16	1.24	46.17	32.35	5.72
Red Top.....	5	8.13	7.25	1.57	48.18	29.80	5.07
Rowen, sun dried.....	2	14.28	11.91	3.38	36.79	25.24	8.40
Rye Straw.....	2	11.11	4.54	1.84	38.37	38.75	5.39
Salt Marsh Hay.....	11	10.47	5.90	2.32	42.42	31.47	7.42
Seradella.....	2	7.95	15.24	2.43	45.92	22.78	5.68
Timothy.....	66	12.60	6.16	2.35	45.34	29.49	4.06
Vetch.....	2	8.90	13.75	2.27	39.92	27.66	7.50
Wheat Straw.....	2	12.18	3.98	1.36	36.52	40.40	5.56
Grains, Fruits and Vegetables.							
Apples.....	5	81.78	0.69	0.41	15.31	1.49	0.32
Apple Pomace.....	5	77.49	1 37	1.39	15.04	4.19	0.52
Barley.....	9	10.92	12.39	1.86	69.88	2.57	2.38
Beans.....	1	12.39	22.17	1.38	53.14	7.21	3.71
Beets, red.....	2	88.57	1.60	0.18	7.42	1.15	1.08
Beets, sugar.....	7	86.97	2.01	0.08	9.12	0.88	0.94
Buckwheat.....	8	12.60	10.00	2.25	64.45	8.70	2.00
Broom Corn Seed.....	1	14.10	9.63	3.48	63.61	7.16	2.02
Cabbage.....	1	93.59	2.01	0.19	2.05	1.44	0.72
Carrot.....	5	87.96	1.22	0.46	7.86	1.45	1.05
Cow Pea.....	5	14.79	20.77	1.43	55.75	4.06	3.20
Mangold.....	5	91.76	1.53	0.15	4.67	0.86	1.03
Maize—Sweet Corn.....	26	8.82	11.62	8.14	66.70	2.80	1.92
Maize—Western Corn....	3	19.10	8.30	3.70	65.95	1.75	1.20
Maize—average.....	201	10.52	10.59	5.44	69.81	2.09	1.55
Oats.....	28	11.18	11.13	4.73	59.32	10.46	2.98
Onion.....	8	87.98	1.33	0.25	9.23	0.68	0.53
Okra.....	1	87.41	1.99	0.40	6.04	3.42	0.74

COMPOSITION OF FODDERS.

Substance.	Number of Analyses.	Water.	Protein.	Fat.	Nitrogen-free Extract.	Crude Fibre.	Ash.
Potatoes—raw	9	78 10	2.19	0.10	18.19	0.54	0.88
Potatoes—boiled	1	75.37	2.63	0.07	20.37	0.68	0.88
Pumpkin	1	92.27	1.11	0.16	4.34	1.49	0.63
Ruta-bagas	1	87.08	1.15	0.09	9.11	1.16	1.41
Rye	6	11.60	10.60	1.70	72.60	1.60	1.90
String-beans	1	83.46	2.75	0.34	10.04	2.58	0.83
Sweet Potatoes	4	71.31	1.63	0.39	24.07	1.56	1.04
Squash	2	94.88	0.66	0.28	3.24	0.54	0.40
Tomatoes	1	91.26	1.00	0.47	5.84	0.70	0.73
Turnips	2	90.64	1.30	0.16	6.15	1.03	0.72
Wheat	312	10.56	11.80	2.11	71.87	1.80	1.86
Flours and Meals.							
Barley Meal	3	15.10	11 80	1.70	70.80	0.10	0.50
Broom Corn Seed Meal	1	13.54	9.63	3.57	64.24	6.92	2.10
Buckwheat Flour	3	13.52	6.48	1.33	77.34	0.28	1.05
Corn Meal	70	15.58	9.13	3.85	68.12	1.89	1.43
Corn and Cob Meal, whole Ear	2	10.08	9 90	4.70	68.35	5.26	1.71
Graham Flour	3	13.10	11.70	1.70	69.80	1.90	1.80
Oat Meal	6	7.85	14.66	7.06	67.57	0.86	2.00
Pea Meal	2	10.47	20.23	1.19	51.08	14.38	2.65
Rye Flour	4	13.10	6.65	0.84	78.28	0.41	0.72
Wheat Flour	26	12.59	11.25	1.19	74.11	0.31	0.55
By-Products and Refuse.							
Beef Scrap	1	1.33	57.69	32.95	.....	.....	8.03
Brewer's Grains, wet from brewing	21	75.46	5.35	1.57	12.77	3.86	0.99
Brewers' Grains, dried	3	8.19	19.89	5.56	51.77	11.01	3.58
Brewers' Grains, kiln-dried	1	2.57	20.30	6.40	54.97	11.79	3.97
Brewers' Grains, from Silo	3	69.82	6.64	2.11	15 58	4.64	1.21
Brewers' Swill	1	94.30	1.90	0.80	2.00	0.70	0.30
Broom Corn Waste	1	8.70	6.19	0.91	43.91	35.84	4.46
Buckwheat Middlings	1	16.33	30.31	7.55	36.29	4.02	5.50
Corn Cobs	13	9.33	2.50	0.47	56.01	30.36	1.33
Cotton Seed Meal	29	8.87	41.90	13.23	22.98	5.76	7.26
Dried Blood	1	6.69	65.12	16.23	5.32	.....	6.64
Gluten Meal	17	9.64	26.78	6.66	53.14	3.03	0.75

COMPOSITION OF FODDERS.

Substance.	Number of Analyses.	Water.	Protein.	Fat.	Nitrogen-free Extract.	Crude Fibre.	Ash.
Hominy Feed	14	11.37	9.82	7.93	64.94	3.50	2.44
Linseed Meal, oil not removed	1	8.33	22.97	30.26	25.48	9.60	3.36
Linseed Meal, new process.	12	10.75	32.85	3.08	38.29	9.46	5.57
Linseed Meal, old process.	22	9.51	31.65	7.59	35.21	10.51	5.53
Linseed Cake	4	10.02	33.77	5.04	36.68	8.52	5.97
Malt Sprouts	3	10.28	22.95	1.79	48.59	10.72	5.67
Pork Scraps	1	0.81	57.35	39.60	.....	.....	2.24
Rye Bran	6	10.93	15.35	2.52	64.13	3.50	3.57
Rye Middlings	1	12.54	11.50	4.91	64.30	3.24	3.52
Sorghum Bagasse	3	85.50	0.65	.....	10.15	3.10	0.60
Starch Feed	2	65.66	5.73	3.02	22.21	3.17	0.21
Sugar Feed	8	8.50	13.30	8.60	58.10	9.50	2.00
Wheat Bran	66	12.52	15.02	3.53	53.94	9.31	5.68
Wheat Middlings	28	11.88	15.06	3.91	61.67	4.32	3.16
Wheat Shorts	8	12.74	13.83	4.14	57.59	7.45	4.25

DIGESTIBILITY OF FODDERS.

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When an animal takes food into its stomach, part of the food is broken down, digested, and dissolved by the action of the various juices; but part resists this action and passes through the animal undigested. It is only the part that has been actually digested and taken up into the circulation of the animal that does any good, and it is with this part alone that we are concerned in studying the subject of cattle feeding. Each of these parts into which we have analyzed the fodder must be again broken up into the portion of it which is digestible and that which is undigestible. There is no constant ratio between the digestible and undigestible proportion of the ingredients in different fodders; each one has to be analyzed and its digestible portion determined by itself. Two general methods have been proposed for the determination of the digestibility of fodders. By the first, fodders which have been previously analyzed are fed in known quantities to animals, the faeces, which represent the undigested portion, collected, analyzed, and the difference between the amounts fed and the amounts left undigested is the digestible part. Many hundred of these digestion experiments have been conducted in Germany and a few in this country. As their result we have the per cent digestible of most of the ordinary farm crops. The second method of determining digestibility is by the use of artificial digestive solutions which are made to represent as nearly as possible the solutions found in the animal stomach. The fodder is mixed with these for certain periods at the same temperature as that of the stomach, and the amount dissolved by this treatment is taken to represent the amount that would have been digested by the animal had it been fed the same fodder. The agreement of the results obtained by these two methods is not so close as is to be desired, but the latter method has only lately been tried and is susceptible of great

improvement. It is probable that before long this method of artificial digestion will be so perfected as to give us fully as reliable results and probably much more reliable than we could get by actually feeding the animals themselves.

In the next table is given the percentage of each of the parts of the feeding material that is digestible. These figures are taken principally from German work. Use has also been made of the tables in former reports of the Connecticut Experiment Station, and in Armsby's Manual of Cattle Feeding.

DIGESTIBILITY OF FEEDING STUFFS (DIGESTION COEFFICIENTS—TABLE II.

Substance.	Protein.	Fat.	N. Free Ex.	Fibre.
Green Fodder.				
Alfalfa	78	42	70	42
Beet Leaves	58	46	100	
Cabbage Leaves	71	60	100	
Carrot Leaves	58	46	100	
Fodder Corn	73	75	67	72
Red Clover	70	63	75	54
Rye Fodder	58	46	100	
Sorghum	62	85	78	60
White Lupine	75	30	64	73
Hay and Coarse Dry Fodder.				
Alfalfa	75	39	65	43
Clover	55	54	67	44
Hay	57	48	62	58
Oat Straw	40	30	44	60
Rowen, sun dried	61	46	66	63
Rye Straw	23	32	37	58
Seradella	71	60	100	
Vetch	76	60	66	54
Wheat Straw	17	36	39	56
Grains, Fruits and Vegetables.				
Barley	77	100	87	20
Beans	88	92	93	69
Beets, sugar	62		95	
Buckwheat	57	46	100	
Cabbage	71	60	100	
Mangold	76		95	
Maize (all kinds)	81	75	93	62
Oats	82	80	75	23
Potatoes, raw	69		96	55
Turnip	57		89	
By-Products and Refuse.				
Brewers' Grains	73	84	64	39
Cotton Seed Meal	85	88	95	
Dried Blood	67	100	96	
Linseed Meal	82	91	73	30
Linseed Cake	86	90	80	44
Malt Sprouts	80	80	100	
Rye Bran	66	58	75	7
Wheat Bran	78	69	77	25

DIGESTIBLE PORTIONS OF FODDERS—TABLE III.

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The accompanying table is derived from the two already given. It is obtained by multiplying the amount of each ingredient of the fodder by the per cent of it that is digestible. An example will make this plain. The first fodder given in Table I is *Alfalfa*. It is there stated to contain in each 100 lbs. 5.91 lbs. of protein. In Table II, opposite alfalfa we find that 78 per cent of this protein is digestible. $5.91 \times 78 = 4.61$. Hence each 100 lbs. of alfalfa contains 4.61 lbs. of digestible protein. The other ingredients are calculated in the same way.

Alfalfa.

	Total Amount.		Percentage of Digestibility.		Amount Digestible.
Protein	5.91	×	78	=	4.61
Fat	1.15	×	42	=	0.48
Non-nitrogenous Extract Matter	12.02	×	70	=	8.41
Crude Fibre	10.57	×	42	=	4.44

To find the amount digestible in a ton, multiply the figures in the table by 20. Thus $4.61 \times 20 = 92$ 2. lbs. of digestible protein in a ton of alfalfa.

The next to the last column is headed Nutritive Ratio. This means the proportion between the digestible albuminoids or muscle producing part of the fodder and the digestible carb-hydrates or heat-producing part. This ratio is found as follows: The amount of digestible fat is multiplied by $2\frac{1}{2}$; to this is added the amount of digestible carb-hydrates and the same divided by the digestible albuminoids. An example will show what is meant.

ALFALFA.

Digestible Non-nitrogenous Extract.....	8.41
Digestible Fibre.....	4.44
Digestible Fat, 0.48 × 2½ =.....	1.20
Total of Digestible Non-nitrogenous Matter.	14.05

The Digestible Protein is 4.61.

14.05 ÷ 4.61 = 3.1.

Green alfalfa has 3.1 times as much digestible non-nitrogenous as nitrogenous matter. That is, it has one part of digestible nitrogenous matter or protein to 3.1 parts of digestible non-nitrogenous matter, hence we say its nutritive ratio is 1 : 3.1.

The last column is headed Relative Value per Ton. This is figured on the basis of 4⅓ cents per pound for digestible fat and digestible protein and 9-10 of a cent per pound for digestible carb-hydrates.

We will use alfalfa again as an example:

Digestible Protein.....4.61 × .04⅓ =	$.199
Digestible Fat.....0.48 × .04⅓ =	.021
Digestible Non-nitrogenous Matter.....8.41 × .009 =	.076
Digestible Fibre.....4.44 × .009 =	.040
Relative value of 100 lbs.....	$.336
Relative value of 2000 lbs.....	$6.72

It will be seen from this table that hay has a valuation of about $12 per ton and corn meal $22 per ton. Their feeding values, then, are in the proportion of 12 : 22, but if hay can be bought for $8 a ton on the farm, then to get corn meal proportionally as cheap it should be purchased for ⅓ less or about $15 per ton. If on the contrary a man had to pay $15 per ton for hay, corn meal then ought to be worth about $27.

DIGESTIBLE PORTIONS OF FODDERS.—TABLE III.

SUBSTANCE.	Digestible Protein.	Digestible Fat.	Digestible Nitrogen-free Extract.	Digestible Fibre.	Nutritive Ratio.	Value per ton.
Green Fodder.						
Alfalfa	4.61	0.48	8.41	4.41	3.0	$6.72
Amber Cane	0.73	0.33	7 27	3.56	15.9	2.87
Beet Leaves	1.59	0.28	2.49		2.0	2.07
Cabbage Leaves	1.30	0.28	3.51		3.2	2.00
Carrot Leaves	2.67	0.40	5.97		2.6	3.73
Cow Pea Vines	2.10	0.28	5.11	3.39	4.4	3.59
Fodder Corn	1.20	0.34	7.20	3.91	9.9	3.33
Orchard Grass	1.51	0.56	7.74	5.93	9.9	4.25
Red Clover	3.14	0.80	10.44	5.24	5.6	6.23
Sorghum	0.69	0.31	10.19	3.74	21.3	3.37
Timothy	1.85	0.63	14.58	8.11	13.1	6.23
White Lupine	2.06	0.11	4.00	3.34	3.7	3.20
Ensilage.						
Apple Pomace	1.09	0.97	7.66	2.92	11.9	3.69
Cabbage	0.84	0.56	4.52		7.0	2.03
Clover	2.34	0.64	7.66	3.60	5.5	4.61
Corn Stalks	2.64	1.85	16.62	5.84	10.3	7.93
Fodder Corn	1.12	0.54	7.10	4.09	11.2	3.45
Cow Pea Vines	1.87	0.48	5.24	2.62	4.8	3.45
Hungarian	1.88	1.07	11.03	7.88	11.5	5.96
Rowen	1.41	0.58	5.35	3.30	7.1	3.28
Rye Fodder	1.38	0.12	9.18		6.9	2.95
Sorghum	0.47	0.24	12.34	3.77	35.5	3.51
Hay and Coarse Dry Fodder.						
Alfalfa	8.29	0.64	30.06	11.11	5.2	15.14
Alsike Clover	7.22	1.57	26.84	11.12	5.8	14.44
Buckwheat Straw	1.54	0.47	14.61	27.53	28.1	9.33
Clover	6.74	1.61	25.92	11.66	6.2	14.00
Clover Rowen, dry	6.09	1.73	24.36	12.67	6.8	13.44
Corn Stover	4.46	1.24	29.15	18.03	11.3	13.43
Cow Pea	11.99	2.09	28.86	9.78	3.7	19.15
Cow Pea Vines, dry	12.23	1.72	29.10	9.32	3 5	19.00
Fodder Corn	3.13	0.93	24.09	15.94	13.5	10.72
Hay of Timothy and Redtop	3.71	1.18	24.39	18.70	12.4	11 99

DIGESTIBLE PORTIONS OF FODDERS.

SUBSTANCE.	Digestible Protein.	Digestible Fat.	Digestible Nitrogen-free Extract.	Digestible Fibre.	Nutritive Ratio.	Value per ton.
Hay of Barley (seed in milk)..	5.25	1.19	29.44	15.16	9.1	13.61
Hay with much Clover.....	5.83	1.32	27.03	13.24	7.5	13.44
Hay of Oats (in blossom).....	3.51	1.31	29.02	18.48	14.5	12.72
Hay of Oats (seed in milk)...	5.04	1.32	27.72	16.28	9.4	13.43
Hay of Ripe Oats.....	3.15	1.14	27.70	19.23	15.8	12.16
Hay of Winter Rye.....	5.56	1.13	26.88	17.49	8.4	13.78
High Meadow Hay.....	4.84	1.10	32.09	16.24	10.6	13.84
Horse Bean Straw..... ..	6.86	0.82	23.68	17.70	6.3	14.10
Hungarian Grass.....	3.87	1.27	31.30	16.87	13.3	13.12
Low Meadow Hay.....	4.00	0.99	26.16	16.91	11.4	12.08
Oat Straw.....	1.34	0.68	16.05	25.34	32.2	9.20
Orchard Grass Hay.....	4.67	1.18	25.44	19.20	10.2	13.10
Pearl Millet.....	4.08	0.57	29.09	18.76	12.1	12.64
Redtop.....	4.13	0.72	30.35	17.28	11.9	12.77
Rowen, sun dried.....	7.27	1.56	24.28	15.90	6.1	14.88
Rye Straw.....	1.04	0.59	14.19	22.48	36.7	8.01
Salt Marsh Hay.....	3.07	1.04	25.45	17.62	14.9	11.31
Seradella.....	10.82	1.46	45.92	... .	4.6	18.90
Timothy.....	3.51	1.08	28.56	17.10	13.7	12.19
Vetch	10.45	1.36	26.35	14.94	4.3	17.66
Wheat Straw.....	0.68	0.49	14.24	22.62	56.0	7.65
Grains, Fruits and Vegetables.						
Apples.....	0.62	0.37	13.78	1.34	25.9	3.58
Apple Pomace.....	1.23	1.25	13.54	3.77	16.6	5.26
Barley.....	9.54	1.86	60.80	0.51	6.9	20.91
Beans.....	19.51	1.27	49.42	4.97	2.9	27.80
Beets, Red.....	0.99	.....	7.05	.....	7.1	2.13
Beets, Sugar.....	1.25	.....	8.66	.....	6.9	2.64
Buckwheat.....	5.70	1.04	64.45	.....	11.8	17.44
Broom Corn Seed.....	7 61	3.03	57.89	3.01	9.0	20.18
Cabbage.....	1.43	0.11	2.05	.....	1.6	1.70
Carrots.....	0.93	0.46	7.07	1.38	10.3	2.72
Cow Pea.....	18.28	1.31	51.85	2.80	3.2	26.80
Mangolds.....	1.16	.....	4.64	.....	4.0	1.84
Maize—Sweet Corn.....	9.41	6.11	62.03	1.74	8.4	24.92
Maize—Western Corn.....	6.72	2.78	61.33	1.09	10.3	19.46
Maize—Average..	8.58	4.08	64.92	1.30	8.9	22.88
Oats.....	9.13	3.78	44.49	2.41	6.2	19.62

DIGESTIBLE PORTIONS OF FODDERS.

Substance.	Digestible Protein.	Digestible Fat.	Digestible Nitrogen-free Extract.	Digestible Fibre.	Nutritive Ratio.	Value per ton.
Onion	0.76	0.25	8.31	0.68	12.7	2.49
Potatoes, raw	1.51	.....	17.46	0.30	11.8	4.50
Potatoes, boiled	1.81	.....	19.52	0.37	10.9	5.15
Rutabagas	0.66	.....	8.11	.....	12.2	2.03
Rye	8.69	1 36	54.45	0.37	6.7	18.57
Sweet Potatoes	1.12	.....	23.11	0.86	21.4	5.28
Squash	0.66	0.28	3.24	0.54	6.8	1.49
Tomatoes	1.00	0.47	5 84	0.70	7.7	2.45
Turnips	0.74	.....	5.47	.....	7.4	1.62
Wheat	9.56	1.58	66.84	1.12	7.5	21.88
Flours and Meals.						
Barley Meal	9.10	1.70	61.60	0.02	7.2	20.44
Broom Corn Seed Meal	7.61	3.11	58.46	2.91	9.1	20.33
Buckwheat Flour	3.69	0.61	77.34	.....	21.4	17.65
Corn Meal	7.40	2.89	63.35	1.17	9.7	20.53
Corn and Cob Meal, whole ear	7.13	3.20	55.36	3.16	9.3	19.48
Graham Flour	9.48	1.28	64.91	1.18	7.3	21.21
Oat Meal	12.02	5.65	50.68	0.20	5.4	24.46
Pea Meal	18.00	0.89	47.50	9.49	3.3	26.62
Rye Flour	5.45	0.67	58.71	0.09	11.1	15.88
Wheat Flour	9.11	0.89	68.92	0.19	7.8	21.10
By-Products and Refuse.						
Beef Scrap	54.81	32.29	.....	.....	.....	75.42
Brewers' Grains wet from brewery	3.91	1.32	8.17	1.48	3.6	6.27
Brewers' Grains, dried	14.52	4.67	33.13	4.29	3.4	23.35
Brewers' Grains, kiln-dried	14.82	5.38	35.18	4.60	3.6	24.65
Brewers' Grains from silo	4.85	1.77	9.97	1.81	3.3	7.85
Brewers' Swill	1.39	0.67	1.28	0.27	2.3	2.06
Broom Corn Waste	4.89	0.79	39.96	15.05	11.6	14.82
Buckwheat Middlings	23.64	5.21	27.94	1.01	1.8	30.20
Cotton Seed Meal	35.62	11.64	21.83	.....	1.4	44.86
Dried Blood	43.63	16.23	5.11	.....	....	52.76
Gluten Meal	21.69	5.00	49.42	1.88	2.9	32.34
Hominy Feed	7.95	5.95	60.39	2.17	9.7	23.30
Linseed Meal, oil not removed	18.84	27.53	18.60	1.92	4.7	43.85

DIGESTIBLE PORTIONS OF FODDERS.

Substance.	Digestible Protein.	Digestible Fat.	Digestible Nitrogen-free Extract.	Digestible Fibre.	Nutritive Ratio.	Value per ton.
Linseed Meal, new process	26.94	2.80	27.95	1.89	1.4	31.13
Linseed Meal, old process	25.95	6.91	25.70	2.10	1.7	33.46
Linseed Cake	29.04	4.54	29.34	3.75	1.5	35.04
Malt Sprouts	18.36	1.43	48.59	.....	2.8	25.88
Pork Scraps	54.48	38.81	.....	.....	....	80.79
Rye Bran	10.13	1.46	48.10	2.45	5.3	19.14
Rye Middlings	7.59	2.85	47.23	2.27	7.5	17.95
Sorghum Bagasse	0.40	.....	7.92	1.86	24.4	2.11
Starch Feed	4.64	2.27	20.66	1 97	6.1	10.06
Sugar Feed	10.77	6.45	54.03	5.89	7.1	25.70
Wheat Bran	11.72	2.44	41.53	2.33	4.3	20.16
Wheat Middlings	11.75	2.70	47.49	1.08	4.7	21.26
Wheat Shorts	10.79	2.86	44.34	1.86	4.9	20.14

FERTILIZING VALUE OF FODDERS.

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In this table is given the number of pounds of nitrogen, phosphoric acid and potash that is contained in a ton of the different fodders and the value of this, calculated in the same way as commercial fertilizers are valued. Nitrogen is valued at 17 cents a pound, phosphoric acid 6 cents and potash 4½ cents. Two points need to be noticed in regard to these valuations. They represent the value of the fertilizer that is in the fodder, before it is fed, and we shall have to subtract 20 per cent from these valuations to get the value of what we should actually obtain in the manure pile. Secondly, these valuations are the prices at the large markets and in the unmixed condition, and when a farmer in this State buys a fertilizer he has to pay not only this price, but additionally for the cost of mixing, bagging, freight, agents' commissions, etc. This additional amount in Vermont this year is about ¼ of the city price. We should therefore add this ¼ to the valuations to get what it would actually cost the farmers to buy the same amount of plant food in the form of commercial fertilizers. But if from a number we subtract 20 per cent and then add to the remainder 25 per cent of itself we get just our original number. The valuations then as given in the table to represent the amount contained in the fodder will also represent the price which the farmer would have to pay delivered on his farm for the same amount of plant food in the form of commercial fertilizer as will be left in the manure produced from that fodder.

FERTILIZING VALUE OF FODDERS—TABLE IV.

Substance.	Nitrogen.	Phosphoric Acid.	Potash.	Valuation per Ton.
Green Fodder.				
Alfalfa	14.0	3.0	9.0	$2.94
Clover, Red	11.7	2.6	11.1	2.62
Clover, Swedish	10.4	2.0	7.0	2.19
Clover, White	10.0	4.0	4.8	2.14
Corn Fodder	4.8	2.2	7.8	1.28
Cow Pea Vines	7.2	2.7	6.0	1.64
Horse Bean (in blossom)	8.2	1.6	7.0	1.79
Hungarian Millet	10.6	2.6	17.2	2.69
Meadow Grass	9.6	3.0	12.0	2.32
Oats, green	6.6	3.1	13.6	1.89
Rye Fodder	9.5	4.8	12.6	2.44
Seradella	8.2	2.8	8.5	1.92
Sorghum	4.0	1.1	3.7	1.50
Timothy	10.8	4.6	12.2	2.63
Vetches, green	9.8	4.0	13.2	2.47
Vetch and Oats	5.0	1.9	15.8	1.64
White Lupine	8.8	1.0	5.0	1.77
Young Grass	11.2	4.4	23.2	3.15
Ensilage.				
Corn Fodder	6.0	2.5	6.8	1.46
Sorghum	2.4	1.0	3.8	0.63
Hay and Coarse Dry Fodder.				
Alfalfa	39.3	9.5	35.6	8.76
Alsike Clover	47.3	16.0	43.5	10.85
Barley Straw	10.0	4.0	19.4	2.77
Bean Straw	20.0	8.2	51.8	6.09
Buckwheat Straw	12.4	12.3	42.2	4.64
Clover Hay	36.6	13.2	44.0	8.88
Clover, Red, in blossom	39.4	11.2	39.0	9.03
Clover, Red, ripe	30.0	7.0	24.4	6.56
Clover, White	47.6	17.0	21.2	10.01
Corn Stalks	16.8	8.2	29.4	4.60
Cow Pea Vines	50.2	8.2	28.0	10.22
Fodder Corn	13.2	3.9	7.5	2.80
Hay	25.0	9.3	41.7	6.58
Hay, dead ripe	24.0	5.8	10.0	4.86

FERTILIZING VALUE OF FODDERS.

Substance.	Nitrogen.	Phosphoric Acid.	Potash.	Valuation per ton.
Meadow Hay	34.6	8.1	32.8	$7.76
Oats, green	29.4	10.2	48.2	7.66
Oat Straw	10.4	5.3	26.7	3.23
Orchard Grass	26.2	8.3	37.6	6.55
Peas, green	45.6	19.4	59.2	11.43
Red Top	22.9	7.2	20.4	5.19
Rowen	38.6	7.3	57.2	9.43
Rye Straw	14.6	7.4	20.2	3.78
Seradella	50.8	18.0	52.0	11.92
Sorghum Leaves	30.4	10.4	22.4	6.74
Timothy Hay	25.1	10.0	31.6	6.21
Vetches, green	45.4	18.8	61.8	11.47
Wheat Chaff	13.6	19.0	11.2	3.93
Wheat Straw	12.8	4.7	14.5	3.07
Grains, Fruits and Vegetables.				
Apples	2.7	0.2	3.9	0.64
Barley	36.8	14.5	8.7	7.50
Beans	82.0	23.2	24.0	16.35
Beets, Sugar	5.6	0.6	3.6	1.14
Broom Corn Seed	34.2	14.4	10.4	7.12
Buckwheat	30.4	12.2	8.0	6.24
Carrot	3.3	2.0	7.7	1.01
Corn, Kernals	35.2	13.6	8.0	7.14
Corn and Oats (equal parts)	32.2	14.4	8.6	6.70
Corn and Oats (2-3 corn, 1-3 oats)	28.0	13.0	8.4	5.90
Cotton Seed Kernels	99.6	34.4	22.8	19.96
Cow Pea Seed	66.4	20.2	20.2	13.36
Flaxseed	72.0	30.8	24.6	15.14
Mangolds	4.6	0.9	8.4	1.19
Millet—with husk	46.4	18.2	9.4	9.38
Millet—without husk	40.0	13.2	4.6	7.78
Oats	38.7	14.2	10.3	7.87
Oats, heavy	37.0	15.4	10.4	7.65
Oats, light	33.8	15.6	11.4	7.16
Peas	72.0	17.6	19.6	14.13
Potatoes	6.5	3.4	11.4	1.79
Rye	34.6	16.2	10.7	7.31
Sorghum Seed	30.2	16.2	7.5	6.42
Turnips	3.9	1.4	5.8	0.99
Turnips, Swedes	4.8	1.2	4.0	1.06

FERTILIZING VALUE OF FODDERS.

SUBSTANCE.	Nitrogen.	Phosphoric Acid.	Potash.	Valuation per ton.
Vetch	88.0	15.8	12.6	$16 45
Wheat (winter)	37.6	19.6	10.6	8.02
Wheat (spring)	40.0	17.2	11.2	8.31
Wheat (average)	37.8	17.2	10.5	7.91
Flours and Meals.				
Buckwheat Flour	20.8	9.8	3.1	4.26
Corn Meal	29.0	12.8	8.0	6.04
Pea Meal	78.3	17.3	19.8	14.34
Rye Flour	33.6	17.0	13.0	7 28
Wheat Flour	39.7	7.7	6.7	7.49
By-Products and Refuse.				
Apple Pomace	4.5	0.4	2.7	0.90
Brewers' Grains	17.8	6.2	10.0	3.82
Broom Corn Seed Waste (stalks)	17.4	9.2	37.2	5.09
Buckwheat Bran	57.3	31.3	19.7	12.46
Cotton Seed Meal (decorticaled)	120.7	49.6	33.8	24.94
Cotton Seed Hulls	7.0	1.8	26.4	2.42
Corn Bran	22.2	9.8	9.4	4.76
Corn and Cob Meal	25.9	10.9	8.7	5.43
Corn Cob	9.4	2.9	12.8	2.32
Gluten Meal	99.6	8.5	1.1	17.49
Hominy Meal	31.7	21.8	11.1	7.17
Linseed Cake	102.4	37.9	28.9	20.84
Linseed Meal	106.0	38.8	28.2	21.55
Linseed Meal (old process)	98.6	.....	.....	16.76
Linseed Meal (new process)	105.4	43 5	30.9	20 91
Malt Sprouts	74.7	31.8	36.0	16.14
Millet Meal	36.6	11.0	4.6	7.08
Rye Bran	47.5	48.1	28.3	12.16
Rye Middlings	35.3	19.2	12.7	7.69
Sugar Beet Cake	36.0	2.0	7.2	6.55
Wheat Bran	49.7	60.7	31.3	13.42
Wheat Middlings	47.0	22.1	13.0	9.87

FEEDING STANDARDS.—TABLE V.

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The following table (A) gives the total number of pounds of dry or organic matter required per day per 1000 lbs. weight for the different kind of animals mentioned. It also states the number of pounds of protein, non-nitrognious matter, fibre and fat that the dry matter should contain. The total nutritive substances is the sum of these last four elements, and shows the total amount of digestible mattter in the quantity of food or organic matter stated in the first column. The last column shows the nutritive ratio; that is, the proportion of nitrogenous matter which each animal requires in its food, compared with the non-nitrogenous matter, including fibre and fat. For instance, a horse at light work, weighing 1000 lbs. requires a daily ration containing 21 lbs. of dry matter; of this, 11.4 lbs. should be digestible, and this digestible matter should consist of 1.5 lbs. of protein, 9.5 lbs. of non-nitrogenous matter and fibre, and 0.40 lb. of fat. The nutritive ratio is as 1 to 7, that is, to each one lb. of protein there should be 7 lbs. of non-nitrogenous matter, fibre and fat; and so on with the other rations. If the animals weigh less than 1000 lbs. or more, the ration should be increased or diminished accordingly.

A. POUNDS PER DAY PER 1000 POUNDS LIVE WEIGHT.

KIND OF ANIMAL.	Total organic or dry matter.	Protein.	Carbhydrates and fibre.	Fat.	Total nutritive substance.	Nutritive ratio.
Horse at light work	21.0	1.5	9.5	0.40	11.40	1:7.0
Horse at average work	22.5	1.8	11.2	0.60	13.60	1:7.0
Horse at hard work	25.5	2.8	13.4	0.80	17.00	1:5.5
Oxen at rest in stall	17.5	0.7	8.0	0.15	8.85	1:12.0
Oxen at ordinary work	24.0	1.6	11.3	0.30	13.20	1:7.5
Oxen at hard work	26.0	2.4	13.2	0.50	16.10	1:6.0
Oxen fattening, first period	27.0	2.5	15.0	0.50	18.20	1:6.5
Oxen fattening, second period	26.0	3.0	14.8	0.70	18.50	1:5.5
Oxen fattening, third period	25.0	2.7	14.8	0.60	18.10	1:6.0
Milk cows	24.0	2.5	12.5	0.40	15.40	1:5.4
Sheep, wool-producing (coarser breeds)	20.0	1.2	10.3	0.20	11.70	1:9.0
Sheep, wool-producing (finer breeds)	22.5	1.5	11.4	0.25	13.15	1:8.0
Sheep, fattening, first period	26.0	3.0	15.2	0.50	18.70	1:5.5
Sheep, fattening, second period	25.0	3.5	14.4	0.60	18.50	1:4.5
Swine, fattening, first period	36.0	5.0	27.5		32.50	1:5.5
Swine, fattening, second period	31.0	4.0	24.0		28.00	1:6.0
Swine, fattening, third period	23.5	2.7	17.5		20.20	1:6.5

GROWING CATTLE.

Age, months.	Average live weight, per head.	Total organic or dry matter.	Protein.	Carbohydrates and fibre.	Fat.	Total nutritive substance.	Nutritive ratio.
2– 3	150 lbs.	22.0	4.0	13.8	2.0	19.8	1:4.7
3– 6	300 "	23.4	3.2	13.5	1.0	17.7	1:5.0
6–12	500 "	24.0	2.5	13.5	0.6	16.6	1:6.0
11–18	700 "	24.0	2.0	13.0	0.4	15.4	1:7.0
12–24	850 "	24.0	1.6	12.0	0.3	13.9	1:8.0
	GROWING SHEEP.						
5– 6	56 lbs.	28.0	3.2	15.6	0.8	19.6	1:5.5
6– 8	67 "	25.0	2.7	13.3	0.6	16.6	1:5.5
8–11	75 "	23.0	2.1	11.4	0.5	14.0	1:6.0
12–15	82 "	22.5	1.7	10.9	0.4	13.0	1:7.0
18–20	85 "	22.0	1.4	10.4	0.3	12.1	1:8.0
	GROWING FAT PIGS.						
2– 6	50 lbs.	42.0	7.5	30.0		37.5	1:4.0
3– 5	100 "	34.0	5.0	25.0		30.0	1:5.0
5– 6	125 "	31.5	4.3	23.7		28.0	1:5.5
6– 8	170 "	27.0	3.4	20.4		23.8	1:6.0
8–12	250 "	21.0	2.5	16.2		18.7	1:6.5

The next table shows the rations required for growing animals of different weights. These rations are for the animals of the weights given, and are not made out per 1000 lbs. live weight, as were the rations in the first table. Otherwise the explanations above will apply to this table, except that the first column of figures refers to the ages in months; thus the first line shows that growing cattle two to three months old, and weighing about 150 lbs., require the amount of the various food elements specified.

B. POUNDS PER DAY AND HEAD.

Kind of animal.	Total organic or dry matter.	Protein.	Carbhydrates and fibre.	Fat.	Total nutritive substances.	Nutritive ratio.
Growing Cattle.						
2– 3, 150 pounds	3 3	0.6	2.1	0.30	3.00	1:4.7
3– 6, 300 "	7.0	1.0	4.1	0.30	5.40	1:5.0
6–12, 500 "	12.0	1.3	6.8	0.30	8.40	1:6.0
12–18, 700 "	16.8	1.4	9.1	0.28	10.78	1:7.0
18–24, 850 "	20.4	1.4	10.3	0.26	11.96	1:8.0
Growing sheep.						
5– 6, 56 pounds	1.6	0.18	0.87	0.045	1.095	1:5.5
6– 8, 67 "	1.7	0.17	0.85	0.040	1.060	1:5.5
8–11, 75 "	1.7	0.16	0.85	0.037	1.047	1:6.0
11–15, 82 "	1.8	0.14	0.89	0.032	1.062	1:7.0
15–20, 85 "	1.9	0.12	0.88	0.025	1.025	1:8.0
Growing Pigs.						
2– 3, 50 pounds	2.1	0.38	1.50		1.88	1:4.0
3– 5, 100 "	3.4	0.50	2.50		3.00	1:5.0
5– 6, 125 "	3.9	0.54	2.96		3.50	1:5.5
6– 8, 170 "	4.6	0.58	3.47		4.05	1:6.0
8–12, 250 "	5.2	0.62	4.05		4.67	1:6.5

Now it must not be supposed that these tables are perfectly exact, for no two animals are alike. We know very well that no two soils are alike, and that the same fertilizer may give different results on different soils. So too with animals. We must take the feeding standards as a basis, and apply them with common sense.

USE OF THE TABLES.

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As aids to the farmer in feeding stock the foregoing tables may be used for two purposes, first for the figuring out of a ration which he may be at present feeding to find its nutritive ratio and how it agrees with the standard; and secondly and more commonly for figuring out a correct ration from the feeding materials at his disposal. To show how this is done, we will give an example of each method of figuring. First, *to determine nutritive ratio:* Let us suppose for example that we are feeding a ration consisting of nine pounds of early cut hay, nine pounds corn stover, four pounds cotton seed meal, four pounds corn meal, four pounds wheat bran. We want to determine its nutritive ratio and see how it agrees with the standard ration. Turning to table III on page 98, we find high meadow hay which corresponds most nearly with our Vermont early-cut hay, has the following composition: Digestible protein, 4.84, digestible fat, 1.10; digestible nitrogen-free extract, 32.09; digestible fibre, 16.24. Multiplying each of these by nine we get the following amounts of digestible material in our nine pounds of hay:

	POUNDS.
Digestible protein	0.44
Digestible fat	0.10
Digestible nitrogen-free extract matter	2.89
Digestible fibre	1.46

Proceeding in the same way with the other materials, we get the following results in pounds:

	Digestible protein.	Digestible fat.	Digestible nitrogen-free extract matter.	Digestible fibre.
Hay, 9 lbs.	0.44	0.10	2.89	1.46
Corn stalks, 9 lbs.	0.10	0.11	2.62	1.62
Cotton seed meal, 4 lbs.	1.42	0.47	0.87	.....
Corn meal, 4 lbs	0.30	0.12	2.53	0.05
Wheat bran, 4 lbs.	0.47	0.10	1.66	0.09
Total	3.03	0.90	10.57	3.22

Digestible nitrogen-free extract matter..... 10.57
Digestible fibre..... 3.22
Digestible fat, 0.90 x 2½ = ... 2.25

16.04 ÷ 3.03 = 5.3.

Nutritive ratio = ... 1:5.3.

Second, *to compound a ration from a given lot of materials.* Let us suppose that we have hay, a mixture of timothy and clover, corn stalks, corn meal and bran. We wish to combine these in the proper proportions to make a daily ration for the milch cow which shall have a ratio of 1:5.4. To do this, we shall have to take first a trial ratio, figure out its value in the way just done, and then add or subtract from this ration to make it conform to the standard ration. We will take for our trial ration 10 pounds of hay, 6 pounds corn stalks, 3 pounds corn meal, 3 pounds bran. This ration figures out as follows:

	Digestible protein.	Digestible fat.	Digestible nitrogen-free extract matter.	Digestible fibre.	Nutritive ratio.
Timothy and Clover hay, 10 lbs...	0.48	0.11	3.21	1.62	1:7.5
Corn Stalks, 6 lbs.....	0.27	0.07	1.75	1.08	1:11.3
Corn Meal, 4 lbs.....	0.30	0.12	2.52	0.05	1:9.7
Wheat Bran, 3 lbs.....	0.35	0.07	1.25	0.07	1:4.3
Total.....	1.40	0.37	8.73	2.82	1:8.9
Standard.....	2.50	0.40	12.50		1:5.4

We find that the protein is much too low, the fat about right, the carb-hydrates and fibre one pound short. The fact that the nutritive ratio is greater than the standard shows that what is to be added must be of a smaller, i. e. narrower ratio than the standard. To make so great a reduction as from 8.9 to 5.4 will require the addition of some other feeding material whose ratio is much less than 5.4. Let us now try new process linseed meal.

In the ration already.....	1.40	0.37	8.73	2.82	1:8.9
Linseed Meal (new process) 4 lbs.	1.08	0.11	1.12	0.08	1:1.4
Total.....	2.48	0.48	9.85	2.90	
			12.75		1:5.6

This is close enough for practical work.

COMPOUNDING OF RATIONS.

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The economical feeding of farm stock is one of the most important problems now before the farmers of Vermont. In the matter of raising crops they seem to be sufficiently experienced. They have their own experience and that of their ancestor for many years back to guide them in methods of cultivating, proper times and seasons for planting, harvesting, etc., so that there is but little further for them to learn in these directions. But when you come to the feeding out of this produce you enter a field in which but very little thought has been put by the farmers of Vermont. When the country was first settled the land produced abundantly the farm crops, or corn, the cereals, and grass. All the cows were kept in the pasture during the summer and went dry throughout the winter. Their pasture grass gave them a perfect feed during the summer and for a cow not giving milk, hay and corn were as good feeds as could be desired. The dairy in Vermont is undergoing a great change. The pastures have become much poorer and the strong tendency at the present time is toward increasing the size of the dairy, putting more cows on a farm than it will keep through the year, supplementing the pasture with feed at the barn if necessary during the summer and turning the larger part of the force of the farm toward keeping these cows in full flow of milk throughout the long winter season, that is, the summer dairying of Vermont is rapidly changing to winter dairying. But the successful carrying on of a winter dairy means the feeding of large quantities of dry feeds; and at the present prices of farm products, butter, meat, and milk, this feeding must be done with great economy or it will be a financial failure. As will be seen later on when we come to study the compounding of rations, the products of the farm already mentioned, the hay, cereals and corn, do not furnish a correctly balanced ration for cows in full milk during the winter season. It becomes necessary to add to these some

of the concentrated feeds. This is part of the problem of feeding to which the farmers of Vermont as a whole have given but very little consideration. But if they are to be successful and to compete with the low prices of farm produce that is shipped in here from the West, they must economize very largely over their present method of winter feeding in order to make a success of this branch of dairying. This is a part of the work which will require regular study. They cannot learn it from the traditions of their ancestors, nor is it at present found in many of the books which are most easily accessible to our farmers. The science of cattle feeding is of late growth. It is our intention here in as few words as possible to lay down some of the fundamental principles which should govern all farmers in the profitable feeding of farm stock.

Farm animals are fed for a double purpose. We must first give to the animal a sufficiency of feed to keep it alive, to keep its vital organs and the energy of life in existence. But when we have done this and done nothing more we are just so much out of pocket and nothing to show for it. To make any profit we must get from the animal in addition to sustaining its life a certain amount of production either of milk from the cow or flesh or wool from the sheep. To get this production, we must add to the amount of feed necessary to keep the animal alive, a certain surplus which the animal can digest and turn into the work of production. In the keeping the animal alive, we must supply a certain amount of heat and also a certain amount of material which can be changed by the animal into muscular energy. The fodder which we give to our animals can be picked to pieces and analyzed by the chemist, and he finds it to consist of various components which he names according to their office as heat-producing and muscle-producing parts. In general these are characterized by the presence or absence of nitrogen. There cannot be any muscular exertion, any motion even of any of the organs of life, without using up some substance containing nitrogen. On the other hand there are certain things, notably starch and sugar which seem to be more directly concerned with the formation and sustaining of the heat of the body. The science of successful cattle feeding consists in a proper proportion of these two elements of animal food, the heat-producing and muscle-produc-

ing. The proportion between these is called the nutritive ratio, and is always estimated on the digestible portion of the fodder. It is found by taking the amount of digestible crude fibre, adding to it the amount of digestible non-nitrogenous matter, and also adding 2½ times the amount digestible fat, since it used to be considered by the earlier German experimenters that since a pound of fat when burnt would give out 2½ times as much heat as a pound of crude fibre or starch or sugar, that therefore it must have 2½ times as much feeding value. When we divide this sum by the amount of digestible albuminoids we get the nutritive ratio. If this ratio is large, it is called a wide ratio; if it is small, it is called a narrow ratio. A wide ratio, therefore, means a fodder or a ration which has a small amount of albuminoids for the amount of heat-producing materials present; while a narrow ratio or narrow ration is one which contains a large amount of albuminoids or muscle-producing materials for the amount of heat-producing. The name of carbhydrates is often used as a general term for the crude fibre and the non-nitrogenous extract matter. When using this we would divide the fodder into albuminoids, carbhydrates and fat.

What is the proper proportion in which we should feed these two general parts of the fodder? that is, the albuminoids or muscle-producing, and the carbhydrates and fat or heat-producing. An immense amount of labor has been spent in Germany to determine this point and the conclusion arrived at by these German experimenters is that a ratio of 1:5.4 is the best for the milch cow. They have also determined various other ratios which they considered the best for various animals and various uses. These are all given on page 106. By a ratio of 1:5.4 is meant that there should be 5.4 times as much digestible carbhydrates and fat together as there is of digestible albuminoids. This German ratio has been called the theoretical ratio, and yet it is difficult to see why it should be socalled, since it is not the result of theoretical reasoning but it is the result obtained through the experience of many hundred actual feeding trials with animals of various breeds, conditions, and individual characteristics. It is as nearly opposite to a theoretical ratio as can be conceived. There remains however the question to be answered whether we can take these figures arrived at by German experimenters and

use them unchanged in our climate, on our soils, with our fodder crops and with our cattle; and there is the still more important inquiry to be made whether, if this ratio does give as is claimed by German experimenters the maximum amount of production with the minimum amount of feed, there is not some other ratio which while producing a smaller amount of return, yet will make that return at so much less cost as to produce more actual profit. It has been already stated that the albuminoids are the most costly part of the fodder. For the sake of economy then we should use as little as possible of this costly material and put in as much as possible of the cheaper carbhydrates. In hay we find one part of digestible albuminoids to about nine parts of digestible carbhydrates. In the corn fodder and in the grain of corn we find a still larger proportion of the carbhydrates. Even in oats, barley and wheat we still find a much larger amount of the carbhydrates in proportion to the amount of albuminoids than is given in the German ration. We cannot therefore from the ordinary materials produced on the farm produce a ration corresponding to the German standard. To get this we must add to our home-produced materials some of the more concentrated by-products, such as bran, oil meal, cotton-seed meal, etc., which will have to be brought on the farm from without and for which the farmer will have to pay hard cash.

Among all the products of the farm, clover and green grass are almost the only ones which give the proportion found in the German ratio. The fundamental principle of feeding for profit should be to raise on the farm as much as possible of that which is to be fed. To do this to a large extent it would be necessary to feed a wider ration than that given in the German standard. Corn in its various forms, that is, as grain, dry stover, dry fodder corn, green fodder corn, and ensilage, is undoubtedly the cheapest source of animal food which we can grow in this climate, and probably hay comes next. A ration to be profitable, then, must be composed very largely of these fodders, and it will therefore be wider than the German standard. Whatever we buy and bring in from off the farm should be of such a nature that a small amount of it will balance up to make a perfect ration a much larger amount of the cheaper fodders which

we can raise on the farm; that is, they must be rich in the nitrogenous or muscle-producing material. Such materials are found in linseed meal, cotton-seed meal, gluten meal, bran, middlings, brewers' grains, buckwheat middlings, and several others of the by products or refuse material from various manufactures. We have said that a ration of wider proportions than the German standard would probably be a cheaper ration than one as narrow as the Germans desire. Let us calculate the cost of some rations and see how it would be. Taking prices as they are at the present time, we may consider hay worth $8 a ton, good corn fodder $5, corn meal $26, cotton seed meal $26, and bran $20. To make a full day's ration for a cow weighing a thousand pounds according to the German standard would require 9 pounds of hay, 9 pounds of corn stalks, 4 of bran, 4 of corn meal, 3 of cotton seed meal. This would cost at these prices, 20¼ cents. To make the same ration on a basis of 1:7 instead of 1:5.4 would require 12 pounds of hay, 12 pounds of corn stalks, 2 of corn meal, 1 of cotton seed meal, 2 of bran, and this would cost 13¾ cents, making a difference in favor of the wider ratio of 6½ cents per day or $13.00 per yearly feeding period of 200 days. It is not to be expected that the cheaper ration will produce as large an amount of milk as the more concentrated and costly ration, but it is doubtful whether the increased amount of milk would pay for the increased amount of cost. But it will not do to make this rule of feeding too general, to think that it will fit all cases. A man can raise corn for much less than $26 a ton; neither his corn stover nor his hay ought to cost him these prices for production. The nearness to railroad is another important factor. As we get back in the country the value of the produce raised on the farm decreases and the cost of bringing in grain from outside increases; so that what would be a paying investment to the man near the railroad would be a losing one to his neighbor back in the mountains. Another class of farmers would also prove an exception to this rule, and that is the milkmen. They get so much larger price per pound for their milk that they can afford to pay a higher price for the feed which they put into their cows, and with them it pays to feed high and keep the cows producing almost to the utmost limit of their capacity. A milkman should feed—and as a fact most

milkmen in Vermont are feeding—very close to the German ratio. And still another class would prove an exception to the rule, and that is those farmers who are trying to keep more stock than their farms will carry and who must necessarily therefore buy a large quantity of food. For them it will pay better to buy principally of the concentrated feeds and give their animals a ration very close to the German standard. It will be seen, then, that no set rule of feeding can be laid down for the various conditions of our Vermont farmers. But we may recapitulate what we have just said, as follows: That the probability is that milkmen should feed a ratio of 1:5.4; those living near a railroad and overstocking their farms so that they must necessarily buy largely of feed should feed a ratio of 1:5.4. Those living near a railroad and having plenty of land to produce about all that their stock need should feed a ratio of about 1:6.5 or 1:7; and in general, the farther back we get from the railroad the wider the ration to be most profitable until back in some of the hill towns it is undoubtedly true that the cheapest ration is the one we find them so generally using, viz., hay and corn meal, both of their own raising, though this would seem on first thought to be a very one-sided and unphilosophical ration. We give now some rations calculated for the feed of dairy cows for one day per thousand pounds of live weight. These can be modified to suit the weight of the animal, that is, if the cow weighs only 900 pounds, one-tenth would be subtracted from these to make a day's ration, and if the cow weighed more than a thousand pounds a proportionally large amount would be added. The rations give a ratio of about 1:5.4.

No. 1.—9 lbs. Wheat Bran, 3 lbs. Linseed Meal (New Process), 10 lbs. Corn Stalks, 5 lbs Wheat Straw, 3 lbs. Oat Straw.

No. 2.—8 lbs. Corn Meal, 5 lbs. Linseed Meal, 10 lbs. Corn Stalks, 4 lbs. Oat Straw.

No. 3.—3 lbs. Cotton Seed Meal, 4 lbs. Corn Meal, 4 lbs. Bran, 9 lbs. hay, 9 lbs. Corn Fodder.

No. 4.—2 lbs. Cotton Seed Meal, 2 lbs. Linseed Meal, 6 lbs. Barley Meal, 8 lbs. Wheat Straw, 12 lbs. Hay.

No. 5.—2 lbs. Cotton Seed Meal, 3 lbs. Linseed Meal, 4 lbs. Barley Meal, 12 lbs. Straw, 8 lbs. Hay.

No. 6.—5 lbs. Linseed Meal, 5 lbs. Bran or Middlings, 15 lbs. Straw, 5 lbs. Hay.

No. 7.—4 lbs. Gluten Meal, 5 lbs. Wheat Bran, 3 lbs. Corn Meal, 20 lbs. Ensilage, 10 lbs. Hay.

No. 8.—3 lbs. Linseed Meal, 4 lbs. Bran or Middlings, 4 lbs. Corn Meal, 10 lbs. Clover Hay, 30 lbs. Ensilage.

No. 9.—4 lbs. Linseed Meal, 30 lbs. Ensilage, 9 lbs. Clover Hay, 9 lbs. Timothy Hay.

The following rations are calculated per head per day for milch cows, cows weighing from 800 to 900 lbs., as is the case with most of the Jersey cows of the State:

No 10.—2 lbs. Linseed Meal, 4 lbs. Bran, 5 lbs. Hay, 60 lbs. Corn Ensilage.

No. 11.—4 lbs. Corn Meal, 60 lbs. Clover Ensilage.

No. 12.—4 lbs. Bran or Middlings, 40 lbs. Corn Ensilage, 40 lbs. Clover Ensilage.

No. 13.—2 lbs. Cotton Seed Meal, 4 lbs. Bran, 1 lb. Corn Meal, 6 lbs. Corn Stalks, 6 lbs. Straw, 2 lbs. Clover Hay, 30 lbs. Mangolds.

The next three rations are for heavy cows giving large quantities of milk.

No. 14.—4 lbs. Corn Meal, 2 lbs. Cotton Seed Meal, 4 lbs. Wheat Bran, 2 lbs. Linseed Meal, 10 lbs. Straw, 10 lbs. Clover Hay.

No. 15.—4 lbs. Corn Meal, 4 lbs. Cotton Seed Meal, 8 lbs. Wheat Bran, 16 lbs. Hay.

No. 16.—4 lbs. Corn Meal, 4 lbs. Cotton Seed Meal, 8 lbs. Wheat Bran, 18 lbs. Corn Fodder.

No. 17.—4 lbs. Linseed Meal, 1 lb. Cotton Seed Meal, 5 lbs. Barley Meal, 5 lbs. Cob Meal, 16 lbs. Corn Stover.

No. 18.—3 lbs. Cotton Seed Meal, 2 lbs. Bran, 30 lbs. Ensilage, 17 lbs. Hay.

The following rations are calculated in the same way for a day's feed for each thousand pounds of live weight to produce a ratio of about 1:7.

No. 19.—4 lbs. Cob Meal, 2 lbs. Cotton Seed Meal, 1 lb. Oats, 12 lbs. Corn Fodder, 50 lbs. Ensilage.

No. 20.—2 lbs. Linseed Meal, 2 lbs. Corn Meal, 3 lbs. Bran, 30 lbs. Ensilage, 15 lbs. Hay.

No. 21.—2 lbs. Cotton Seed. Meal, 3 lbs. Cob Meal, 2 lbs. Barley, 2 lbs. Bran, 9 lbs. Corn Fodder, 12 lbs. Hay.

No. 22.—2 qts. Cotton Seed Meal, 2 qts. Corn Meal, 2 qts. Bran, 22 lbs. Hay.

No. 23.—2 lbs. Corn Meal, 2 lbs. Cotton Seed Meal, 3 lbs. Bran, 20 lbs. hay.

No. 24.—1 qt. Cotton Seed Meal, 3 qts. Corn Meal, 3 qts. Bran, 15 lbs. Hay.

No. 25.—3 lbs. Barley, 1 lb. Corn Meal, 1 lb. Oats, 3 lbs. Bran, 11 lbs. Clover Hay, 11 lbs. Timothy Hay.

For cows of the ordinary Jersey size, i. e., 800 to 900 lbs. weight, the following rations can be used, giving a ratio of about 1:7:

No. 26.—1 qt. Cotton Seed Meal, 1 qt. Corn Meal, 3 qts. Oats, 25 lbs. Ensilage, 10 lbs. hay.

No. 27.—3 lbs. Corn Meal, 1 lb. Cotton Seed Meal, 1 lb. Bran, 10 lbs. Clover Hay, 10 lbs. Timothy Hay.

No. 28.—2 lbs. Cob Meal, 2 lbs. Cotton Seed Meal, 2 lbs. Corn Meal, 2 lbs. Barley, 6 lbs. Corn Fodder, 20 lbs. Ensilage, 6 lbs. Hay.

No. 29.—1 qt. Cotton Seed Meal, 2 qts. Bran, 11 lbs. Corn Fodder, 9 lbs. Hay.

The following are examples of rations that are much used on the hill farms of Vermont, back from the railroad:

No. 30.—2 qts. Corn Meal, 2 qts. Bran, 6 lbs. Corn Fodder, 20 lbs. Hay. Nutritive Ratio, 1:10.

No. 31.—3 qts. of mixed Corn and Oats, 25 lbs. Hay. Nutritive Ratio, 1:11.

In connection with the table given on page——of the amounts of digestible material needed by other animals for a day's ration may be given the following:

For fattening cattle per day per 1000 lbs. of live weight.

No. 32.—6 lbs. Linseed Meal, 6 lbs. Corn Meal, 20 lbs. Corn Fodder.

No. 33.—5 lbs. Cotton Seed Meal, 5 lbs. Corn Meal, 20 lbs. of hay.

No. 34.—For 800 lbs weight: 5 lbs. Linseed Meal, 3 lbs. Bran, 10 lbs. Rye Straw, 10 lbs. Hay.

The next two rations can be used to advantage where it is desired to raise on the farm everything that is used for feeding.

No. 35.—10 lbs. Corn Meal, 5 lbs. Corn Stalks, 18 lbs. Clover Hay.

No. 36.—10 lbs. Corn Meal, 25 lbs. Pea and Oat Hay.

FOR OXEN AT HARD WORK.

No. 37.—10 lbs. Corn Meal, 10 lbs. Clover Hay, 10 lbs. Meadow Hay.

No. 38.—10 lbs. Corn Meal, 3 lbs. Wheat Bran, 17 lbs Clover Hay.

No. 39.—4 lbs. Linseed Meal, 5 lbs. Bran, 25 lbs. Oat Straw.

No. 40.—3 lbs. Cotton Seed Meal, 2 lbs. Wheat Bran, 5 lbs. Clover Hay, 20 lbs. Corn Fodder.

For horses heavily worked, per day per 1000 lbs. live weight.

No. 41.—2 lbs. Linseed Meal, 6 lbs. Rye Bran, 10 lbs. Corn Meal, 6 lbs. Corn Fodder, 8 lbs. Clover Hay.

No. 42.—6 lbs. Bran, 12 lbs. Corn Meal, 6 lbs. Meadow Hay, 6 lbs. Clover Hay.

No. 43.—2 lbs. Bran, 6 lbs. Oats, 8 lbs. Corn Meal, 6 lbs. Wheat Straw, 8 lbs. Meadow Hay.

For horses at light work.

No. 44.—12 lbs. Oats, 12 lbs. Hay.

No. 45.—6 lbs. Oats, 4 lbs Corn Meal, 3 lbs. Wheat Bran, 12 lbs. Hay.

It may be said in general, in regard to these rations, that wherever wheat bran is mentioned, buckwheat middlings may be used instead; oats and barley can be interchanged pound for pound; ensilage, corn fodder and hay at three pounds of hay for four of corn fodder or ten pounds of ensilage. A pound each of cotton seed meal and corn meal is about the same as two pounds of gluten meal.

There is another side to the problem of animal food which must never be lost sight of and that is the fertilizing value of the materials we use for fodder. After the animal has eaten the food and given us the production of milk, meat, wool, etc., there is still left in the manure a certain amount of plant food which is valuable to the farmer as a fertilizer, and this value varies very greatly according to the character of the food given. If

we analyze a given feed we find certain amounts of nitrogen, phosphoric acid and potash. This represents just so much plant food that was taken away from the soil when the plant grew. If we were to put this fodder right back on the soil and plow it in, we would return to the soil all that was taken away. If instead of this we put the fodder through the machinery of our animals and then return the manure to our land we do not return all the plant food that was taken away by the growing crop. There is always some loss, varying according to the kind of animals to which the fodder is given. Fed to animals not increasing in weight and not making any production as milk or wool, the loss would be very small. A young animal rapidly growing takes out a much larger amount from its food for the production of its bones and flesh. A cow giving milk also extracts largely from its fodder of this fertilizing material. The average of all farm animals would be much less than 20 pounds of loss. For milch cows it is customary to calculate that 20 per cent or 1-5 of the fertilizing material that was in the fodder will be lost and only 4-5 recovered in the manure. If butter is made and the skim milk is fed on the farm the loss would probably fall under 20 per cent. On pages 101 to 104 is given a table of the fertilizing value of the various fodders used in Vermont. Glancing at this list it will be noticed that there is a very wide difference between the fertilizing value of different fodders, also that fertilizing value and feeding value have no necessary connection to each other; there may be high feeding value without fertilizing value, and there may be high fertilizing value without feeding value. Take, for instance, sugar, starch or fat. Each of these have a high feeding value; it is a valuable animal food, but has no fertilizing value whatever. No amount of it added to a field would ever help the growth of a crop. On the contrary sulphate of ammonia, nitrate of soda, muriate of potash have high fertilizing value but no one would ever think of feeding them to an animal to produce growth. It will be noticed that corn meal has a high feeding value but low fertilizing value, whereas cotton seed meal has both a high feeding and fertilizing value. When a farmer starts out to buy feed, this fertilizing value of the fodder should always be borne in mind, as whatever plant food is bought in this way is acquired more cheaply than by any other method.

COMPOSITION OF VERMONT FODDERS.

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On the following pages will be found the analyses made at the Station the last year, of fodder materials. It will be seen that the Station has analyzed samples of almost everything used in this State as cattle food.

TIMOTHY HAY.

Sent by C. H. Cole, Lunenburgh, Vt. Crop of 1887. Considered by him to be of fair quality. It will be noticed that it has a narrower nutritive ratio, i. e. is of better quality than the average composition of timothy hay as given in table III, page 97.

	Percentage Composition.	Constituents in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per cent of Digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.....	6.65	133.00			
Total Dry Matter.....	93.35	1867.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash.....	5.66	113.20			1:9.01.
Crude Fiber.....	33.86	677.20	392.78	58	
Fat (Ethre Extract).....	4.03	80.60	37.08	46	
Protein (Nitrogenous Matter)...	10.38	207.60	118.33	57	
Non-nitrogenous Extract Matter.	46.07	921.40	580.48	63	
	100.00	2000.00	1128.67		

HAY OF OATS.

Cut when nearly ripe. Sent by H. H. Wheeler, South Burlington, Vt.

	Percentage composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	6.15	123.00			
Total Dry Matter	93.85	1877.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	6.72	134.40			
Crude Fibre	22.43	448.60	174.95	39	1:8.79
Fat (Ether Extract)	4.85	97.00	58.20	60	
Protein (Nitrogenous Matter)	9.12	182.40	116.74	64	
Non-nitrogenous Extract Matter	56.88	1137.60	705.31	62	
	100.00	2000.00	1055.20		

ENSILAGE.

From southern white corn, cut just as it began to tassel. Made and sent by C. H. Cole, Lunenburgh, Vt.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	79.19	1583.80			
Total Dry Matter	20.81	416.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	9.65	193.00			
Crude Fibre	36.59	731.80	526.90	72	1:11.15.
Fat (Ether Extract)	3.72	74.40	55.80	75	
Protein (Nitrogenogs Matter)	7.59	151.80	110.81	73	
Non nitrogenous Extract Matter	42.45	849.00	568.83	67	
	100.00	2000.00	1262.34		

ENSILAGE.

The next three samples of ensilage were sent by George Campbell's Sons, Westminster West, Vt. Of the rowen it was stated: "Put in silo Oct. 5, 1887, after several hard frosts; too ripe for a fair test, but sheep will eat it in preference to nice hay. It was put on top of about fifteen feet of corn ensilage and weighted with sand." Special attention is called to a comparison of this with the samples of corn ensilage. Not only does the rowen ensilage contain twice as much dry matter as the corn ensilage, but this dry matter is also richer in digestible material, and contains this material in a much better proportion for economical stock feeding.

Corn ensilage No. 1 was made from ripe corn fodder, the ears being picked off and the stalks put in silo before frosts. It was allowed to stand and heat four days before weighting.

Corn ensilage No. 2 was made from the same material as preceding, but was weighted as soon as filled, before it could heat on top. There is but a slight difference between the two samples, this little being in favor of weighting at once.

ROWEN ENSILAGE.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	59.59	1191.80			
Total Dry Matter	40.41	808.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	7.75	155.00			1:8.51.
Crude Fibre	25.74	514.80	370.66	72	
Fat (Ether Extract)	5.27	105.40	79.05	75	
Protein (Nitrogenous Matter)	10.09	201.80	147.31	73	
Non-nitrogenous Extract Matter	51.15	1023.00	685.41	67	
	100.00	2000.00	1282.43		

CORN ENSILAGE NO. 1.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	80.06	1601.20			
Total Dry Matter	19.94	398.80			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	7.53	150.60			1:11.57.
Crude Fibre	30.53	610.60	439.63	72	
Fat (Ether Extract)	4.91	98.20	73.65	75	
Protein (Nitrogenous Matter)	7.61	152.20	111.11	73	
Non-nitrogenous Extract Matter	49.42	988.40	662.23	67	
	100.00	2000.00	1286.62		

CORN ENSILAGE NO. 2.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	80.07	1601.40			
Total Dry Matter	19.93	398.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	6.43	128.60			1:12.71.
Crude Fibre	28.35	567.00	408.24	72	
Fat (Ether Extract)	4.76	95.20	71.40	75	
Protein (Nitrogenous Matter)	7.02	140.40	102.49	73	
Non-nitrogenous Extract Matter	53.44	1068.80	716.10	67	
	100.00	2000.00	1298.23		

ALSIKE CLOVER.

Cut by Dr. F. J. Hendee, Burlington, in the fall of 1886.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	13.91	278.20			
Total Dry Matter	86.09	1721.80			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	7.39	147.80			
Crude Fibre	28.57	571.40	268.56	47	1:8.11.
Fat (Ether Extract)	3.66	73.20	43.19	59	
Protein (Nitrogenous Matter)	12.21	244.20	146.52	60	
Non-nitrogenous Extract Matter	48.17	963.40	664.75	69	
	100.00	2000.00	1123.02		

COW PEA (Hay).

Cut on the farm of Mr. G. W. Whitney, Williston, Vt., after it had been injured by a severe frost, September 22, 1887.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	11.00	220.00			
Total Dry Matter	89.00	1780.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	6.90	138.00			
Crude Fibre	18.80	376.00	176.72	47	1:5.41.
Fat (Ether Extract)	2.82	56.40	33.28	59	
Protein (Nitrogenous Matter)	15.84	316.80	190.08	60	
Non-nitrogenous Extract Matter	55.64	1112.80	767.83	69	
	100.00	2000.00	1167.91		

SERADELLA (HAY.)

Cut on the farm of G. W. Whitney, Williston, Vt., when in bloom, July 12, 1887.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	11.71	234.20			
Dry Matter	88.29	1765.80			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	11.72	234.40			
Crude Fibre	21.92	438.40			
Fat (Ether Extract)	3.25	65.00	39.00	60	1:4.66.
Protein (Nitrogenous Matter)	17.27	345.40	217.60	63	
Non-nitrogenous Extract Matter	45.84	916.80	916.80	100	
	100.00	2000.00	1173.40		

WINTER VETCH (HAY).

Cut when in bloom from the field of N. R. Spaulding, Burlington, July 19, 1887. This was raised from seed furnished by the Station, and made a fine growth. It is the richest fodder ever analyzed at the Station.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	11.85	237.00			
Total Dry Matter	88.15	1763.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	6.57	131.40			
Crude Fibre	22.35	447.00	241.38	54	1:2.22.
Fat (Ether Extract)	3.38	67.60	40.56	60	
Protein (Nitrogenous Matter)	26.17	523.40	397.78	76	
Non-nitrogenous Extract Matter	41.53	830.60	539.89	65	
	100.00	2000.00	1219.61		

SPRING VETCH (Hay).

Cut in bloom from field of Geo. W. Whitney, Williston, July 12, 1887.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.....
Moisture at 100° C.	11.08	221.60			
Total Dry Matter	88.92	1778.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	7.97	159.40			
Crude Fibre	29.38	587.60	317.30	54	1:3.45.
Fat (Ether Extract)	2.71	54.20	32.52	60	
Protein (Nitrogenous Matter)	17.98	359.60	273.30	76	
Non-nitrogenous Extract Matter	41.96	839.20	545.48	65	
	100.00	2000.00	1168.60		

YELLOW LUPINE (Hay).

Cut in bloom from field of Geo. W. Whitney, Williston, July 12, 1887.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	9.34	186.80			
Total Dry Matter	90.66	1813.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	8.49	169.80			
Crude Fibre	30.38	607.60	443.55	73	1:5.42.
Fat (Ether Extract)	3.61	72.20	21.66	30	
Protein (Nitrogenous Matter)	13.07	261.40	193.44	74	
Non-nitrogenous Extract Matter	44.45	889.00	551.18	62	
	100.00	2000.00	1209.83		

TEOSINTE.

The next two samples were sent by W. A. Brown, Rocky Hill, Conn. Teosinte is a fodder crop closely allied to sorghum. It has the peculiarity of sending up many stalks from the single seed, and when cut at blossoming time, it produces a second growth from the same root. In the sample sent by Mr. Brown, the first growth was ten feet in height, and the second growth from the same root nearly six feet. Both samples are from the same root. The second growth produced no seed. As would have been expected, the second growth is a little richer than the first.

TEOSINTE—FIRST GROWTH.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	6.78	135.60			
Total Dry Matter	93.22	1864.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	8.18	163.60			1:12.07.
Crude Fibre	32.13	642.60	224.91	35	
Fat (Ether Extract)	3.11	62.20	49.14	79	
Protein (Nitrogenous Matter)	7.31	146.20	81.87	56	
Non-nitrogenous Extract Matter	49.27	985.40	640.51	65	
	100.00	2000.00	996.43		

TEOSINTE—SECOND GROWTH.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	3 31	66.20			
Total Dry Matter	96.69	1933.80			
	100 00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	9.16	183.20			
Crude Fibre.	29.34	586.80	205.38	35	1:10.21.
Fat (Ether Extract)	2.59	51.80	40.92	79	
Protein (Nitrogenous Matter)	8.43	168.60	94.42	56	
Non-nitrogenous Extract Matter	50.48	1009.60	656.24	65	
	100.00	2000.00	996.96		

ALFALFA (Hay).

Cut when just coming in blossom from field of Dr. F. J. Hendee, Burlington, June 28, 1887.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	10.00	200.00			
Total Dry Matter	90.00	1800.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	8.77	175.40			
Crude Fibre	30.13	602.60	241.04	40	1:2.80.
Fat (Ether Extract)	2.23	44.60	17.39	39	
Protein (Nitrogenous Matter)	18.75	375.00	288.75	77	
Non-nitrogenous Extract Matter	40.12	802.40	521.56	65	
	100.00	2000.00	1068.74		

ALFALFA (Hay.)

Cut from same field as preceding, but not until the seed was in the dough, July 7, 1887. The principal difference between the two samples is the less amount of protein in the older growth.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	12.48	249.60			
Total Dry Matter	87.52	1750.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	8.61	172.20			
Crude Fibre	32.81	656.20	262.48	40	1:3.34.
Fat (Ether Extract)	2.37	47.40	18.49	39	
Protein (Nitrogenous Matter)	16.14	322.80	248.56	77	
Non-nitrogenous Extract Matter	40.07	801.40	520.91	65	
	100.00	2000.00	1050.44		

CORN MEAL.

Made at Station from a sample of Brazilian Flour Corn sent by William A. Brown, Rocky Hill, Conn., raised by him during season of 1887.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	11.86	237.20			
Total Dry Matter	88.14	1762.80			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	2.07	41.40			
Crude Fibre	2.14	42.80	14.55	34	1:10.60.
Fat	5.60	112.00	85.12	76	
Protein	9.66	193.20	164.22	85	
Non-nitrogenous Extract Matter	80.53	1610.60	1513.96	94	
	100.00	2000.00	1777.85		

CORN COB.

This was the cob of the Brazilian Flour Corn given above.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	7.87	157.40			
Total Dry Matter	92.13	1842.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	2.96	59.20			1:37.73.
Crude Fibre	28.37	567.40	283.70	50	
Fat (Ether Extract)	1.72	34.40	17.54	51	
Protein (Nitrogenous Matter)	3.05	61.00	25.62	42	
Non-nitrogenous Extract Matter	63.90	1278.00	639.00	50	
	100.00	2000.00	965.86		

GROUND FEED.

A mixture of oats, corn and corn cob, sent by J. W. Newton, Stowe, Vt.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	11.04	220.80			
Total Dry Matter	88.96	1779.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	2.25	45.00			1:8.69.
Crude Fibre	5.70	114.00			
Fat (Ether Extract)	5.38	107.60	101.14	94	
Protein (Nitrogenous Matter)	9.48	189.60	151.68	80	
Non-nitrogenous Extract Matter	77.19	1543.80	1065.22	69	
	100.00	2000.00	1318.04		

COTTON SEED MEAL.

Sent by G. W. Whitney, Williston, Vt.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	6.64	132.80			
Total Dry Matter	93.36	1867.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	8.46	169.20			
Crude Fibre	6.27	125.40			
Fat (Ether Extract)	16.03	320.60	282.13	88	1:1.63.
Protein (Nitrogenous Matter)	43.30	866.00	736.10	85	
Non-Nitrogenous Extract Matter	25.94	518.80	492.86	95	
	100.00	2000.00	1511.09		

BUCKWHEAT MIDDLINGS.

Sent by B. H. Porter, Burlington.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	9.52	190.40			
Total Dry Matter	90.48	1809.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	5.02	100.40			
Crude Fibre	2.68	53.60			
Fat (Ether Extract)	6.27	125.40	57.68	46	1:4.14.
Protein (Nitrogenous Matter)	27.77	555.40	316.58	57	
Non-nitrogenous Extract Matter	58.26	1165.20	1165.20	100	
	100.00	2000.00	1539.46		

BUCKWHEAT BRAN.

Sent by B. H. Porter, Burlington.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	9.03	180.60			
Total Dry Matter	90.97	1819.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:13.64.
Ash	3.76	75.20			
Crude Fibre	34.47	689.40			
Fat (Ether Extract)	2.27	45.40	20.88	46	
Protein (Nitrogenous Matter)	7.08	141.60	80.71	57	
Non-nitrogenous Extract Matter	52.42	1048.40	1048.40	100	
	100.00	2000.00	1159.99		

WHEAT BRAN.

Sent by H. H. Wheeler, South Burlington.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	10.49	209.80			
Total Dry Matter	89.51	1790.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:4.07.
Ash	6.33	126.60			
Crude Fibre	8.86	177.20	40.76	23	
Fat (Ether Extract)	7.26	145.20	101.64	70	
Protein (Nitrogenous Matter)	18.57	371.40	289.69	78	
Non-nitrogenous Extract Matter	58.98	1179.60	884.70	75	
	100.00	2000.00	1316.79		

GLUTEN MEAL.

Sent by H. H. Wheeler, South Burlington.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	10.19	203.80			
Total Dry Matter	89.81	1796.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	0.70	14.00			
Crude Fibre	1.84	36.60	12.44	34	1:2.48.
Fat (Ether Extract)	8.64	172.80	131.33	76	
Protein (Nitrogenous Matter)	32.98	659.60	560.66	85	
Non-nitrogenous Extract Matter	55.85	1117.00	1049.98	94	
	100.00	2000.00	1754.41		

GLUTEN MEAL.

Sent by Allen Hazen, Hartford, Vt.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	9.45	189.00			
Total Dry Matter	90.55	1811.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	0.62	12.40			
Crude Fibre	1.73	34.60	11.76	34	1:2.74.
Fat (Ether Extract)	8.49	169.80	129.05	76	
Protein (Nitrogenous Matter)	30.71	614.20	522.07	85	
Non-nitrogenous Extract Matter	58.45	1169.00	1098.86	94	
	100.00	2000.00	1761.74		

COTTON SEED MEAL.

Sent by H. H. Wheeler, South Burlington.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	6.46	129.20			
Total Dry Matter	93.54	1870.80			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	7.35	147.00			
Crude Fibre	5.75	115.00			1:1 68.
Fat (Ether Extract)	14.14	282.80	248.86	88	
Protein (Nitrogenous Matter)	42.09	841.80	715.53	85	
Non-nitrogenous Extract Matter	30.67	613.40	582.73	95	
	100.00	2000.00	1547.12		

CORN.

Sent by G. W. Whitney, Williston, Vt.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	10.39	207.80			
Total Dry Matter	89.61	1792.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	2.27	45.40			1:8.22.
Crude Fibre	2.04	40.80	13.87	34	
Fat (Ether Extract)	5.83	116.60	88.62	76	
Protein (Nitrogenous Matter)	12.14	242.80	206.38	85	
Non-nitrogenous Extract Matter	77.72	1554.40	1461.14	94	
	100.00	2000.00	1770.01		

GLUTEN MEAL.

Sent by G. W. Whitney, Williston, Vt.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100°	7.97	159.40			
Total Dry Matter	92.03	1840.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	1.82	36.40			
Crude Fibre	1.13	22.60	7.68	34	1:1.91.
Fat (Ether Extract)	7.59	151.80	115.37	76	
Protein (Nitrogenous Matter)	38.62	772.40	656.54	85	
Non-nitrogenous Extract Matter	50.84	1016.80	955.79	94	
	100.00	2000.00	1735.38		

WHEAT BRAN.

Sent by G. W. Whitney, Williston, Vt.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	8.58	171.60			
Total Dry Matter	91.42	1828.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Ash	7.74	154.80			
Crude Fibre	11.54	230.80	53.08	23	1:3.43.
Fat (Ether Extract)	7.60	152.00	106.40	70	
Protein (Nitrogenous Matter)	20.64	412.80	321.98	78	
Non-nitrogenous Extract Matter	52.48	1049.60	787.20	75	
	100.90	2000.00	1268.66		

HAY.

Sent by G. W. Whitney, Williston, Vt.

	Percentage Composition.	Constituents, in lbs. in a ton of 2000 lbs.	Pounds Digestible in a ton of 2000 lbs.	Per Cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	6.48	129.60			
Total Dry Matter	93.52	1870.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:11.18.
Ash	2.22	44.40			
Crude Fibre	28.33	766.60	444.63	58	
Fat (Ether Extract)	3.27	65.40	30.08	46	
Protein (Nitrogenous Extract)	8.80	176.00	100.32	57	
Non-nitrogenous Extract Matter	47.38	947.60	596.99	63	
	100.00	2000.00	1172.02		

ANALYSES OF DRINKING WATER.

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During the year the Station has had occasion to analyze samples of drinking water for several parties. It may be said in general of these samples, that those from springs proved to be good water, while the samples of well water are nearly all very bad.

The first five samples are from different sources of the supply for the new water works of West Randolph. No. VI is from a well in the pasture of Mark Thompson, Shelburn. No. VII from well at house of Geo. W. Whitney, Williston. No. VIII is from well at house of Geo. A. Hall, Burlington. No. IX is from well of L. A. Bishop, Williston. No. X, from well of H. W. Russell, Shelburn.

Number.	Grains per gallon.		Parts per million.	
	Total Solids.	Chlorine.	Free Ammonia.	Albuminoid Ammonia.
I	7.9	0.17	0.013	0.086
II	5.7	0.10	0.004	0.034
III	8.4	0.15	trace.	0.025
IV	7.7	trace.	0.040	0.280
V	8.4	0.30	0.030	0.280
VI	21.5	0.50	0.080	0.500
VII	51.0	5.60	0.080	0.425
VIII	.....	1.60	0.028	0.078
IX	150.4	20.40	*	*
X	.....	7.50	0.020	0.290

In interpreting these results the following rule will be a pretty safe guide, i. e., water is suspicious if it contains 40 grains per gallon of total solids, three grains per gallon of chlorine, 0.05 parts free ammonia per million or 0.10 parts per million of albuminoid ammonia.

* Too much to measure.

DETERMINATION OF CRUDE FIBRE.

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In the analysis of fodders for crude fibre, the most tedious part of the process is the washing with hot water to free the fibre from the acid and later to wash out the alkali. The old process of using filter paper is very slow; the method recommended in the last report of the Association of Official Agricultural Chemists, of squeezing in a linen cloth, hastens matters but is still awkward and not very thorough. In the Station laboratory, the following method has been used the past year, and has given good satisfaction. The stem of a small glass funnel is connected by a rubber tube with a suction pump, (we have the ordinary Richards' pump,) over the mouth of the funnel is stretched a piece of fine linen cloth, fastened to the stem by a small rubber band. After boiling the fodder with acid for half an hour, the pump is started and the funnel *inverted* in the beaker containing the fodder. The solution is sucked out, the cloth acting as the filter, with the advantage over the old way, that when it becomes clogged with the fibre, it can be easily rinsed off by a jet of water. In this way almost the last drop of solution can be drawn off the fibre. The beaker is then half filled with boiling water, shaken and the washing continued as long as desired. The 200 c. c. of soda solution is put into a 250 c. c. wash bottle *fitted with a pressure bulb*, by which the solution can be thrown out in a jet by squeezing with the hand instead of blowing with the mouth. All the fodder can be rinsed off clean from the cloth back into the beaker with this jet; the fibre boiled for half an hour, then washed in the same manner as before. After washing with water, it is transferred to a Gooch crucible for the final washing with alcohol and ether. By this method, the two washings with hot water need not occupy more than five minutes each.

SAMPLING OF MILK.

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In one experiment that was undertaken, fault was found with the milker, because in taking his sample for analysis he dipped off the top of the milk instead of pouring the milk back and forth several times to mix it thoroughly. He replied that he had milked rapidly and had taken the sample at once, before the cream had time to separate; that during the process of milking the streams kept the milk thoroughly stirred, and at the moment of finishing, the quality of the milk was the same in all parts of the pail. To test this, a pint of milk was dipped from the top at the close of milking, then all but a pint of the rest poured out. What remained, with the pint dipped out, were found to analyze as follows:

First pint.....3.83 per cent of fat.
Last pint.....2.96 per cent of fat.

It is evident therefore that some of the strippings remain near the surface, and to get a correct sample to indicate the average quality, the milk should be poured back and forth and thoroughly mixed.

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FINANCIAL STATEMENT.

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Appropriated by State		$7,000 00
Farm	$2,500 00	
Repairs on Station Building	1,179 00	
Repairs at Farm	324 39	
Salaries	928 52	
Apparatus	784 00	
Chemicals	327 31	
Field Experiments on outside farms	191 91	
Water, Gas and Fuel	140 56	
Printing, Stationery and Books	113 23	
Labor at Station	170 50	
Miscellaneous	340 58	
		$7,000 00

NOTE.—The foregoing report covers the work done by the Station up to March 1, 1888, but a long series of vexatious and unnecessary delays on the part of the printer has made the issue of the report from the press so late that it is possible now to include a complete financial statement.